THE FEDERATED
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EST. 1896
MINING INSTITUTE

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will be held in the

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Commencing Wednesday, 2nd February, 1898.

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BEING THE PROCEEDINGS FOR THE YEAR 1897.

Vol. 1 2

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Notes on the Gold-bearing Lodes of Cayoosh Creek, B. C.

By Mr. G. F. Moncton, F.G.S., Vancouver, B.C.

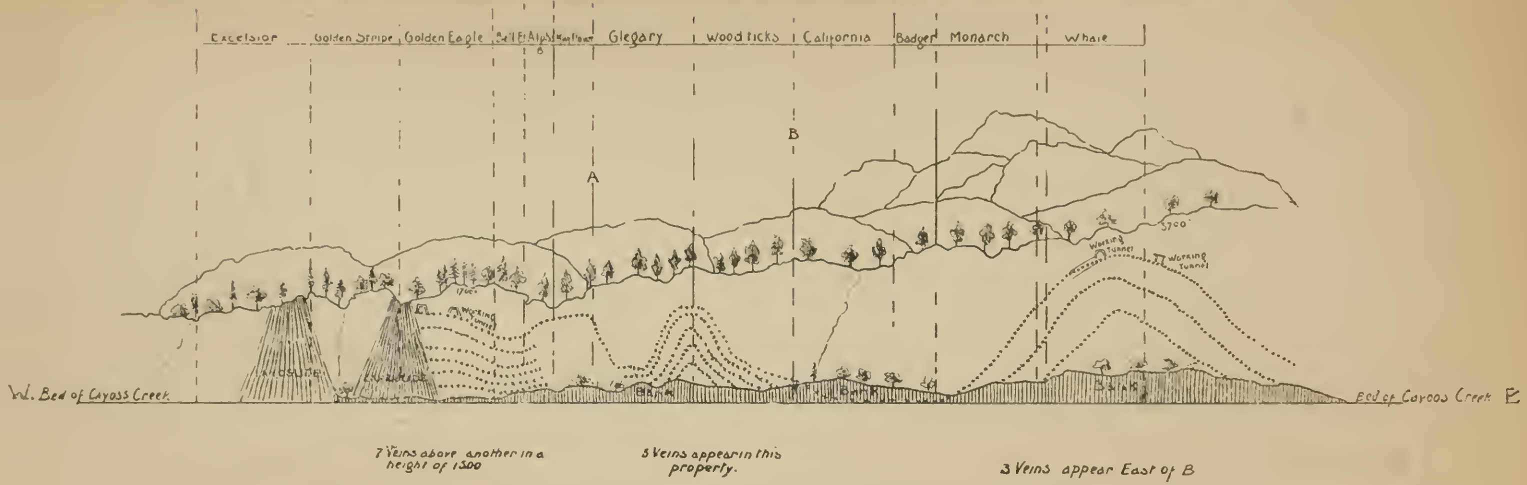
Cayoosh Creek is a river which debouches into the Fraser about one mile below the village of Lillooet. The valley through which it flows is a narrow gorge between very rugged and steep mountains, affording magnificent scenery, many of the bluffs rising sheer to a height of eight hundred feet. These crags expose fine sections of the formation composing the rocks of the district.

The creek can be travelled for the first eight miles by a good waggon road, which is to be extended in the spring, and beyond that there is a good trail for a long distance up the creek. All along the bed of the stream, wherever the current was not too strong, placers have been worked. The most important of these lie below the canon, at which point bed-rock was reached. The auriferous character of the stream was not known until 1886. In the following four years $160,000 were extracted. It is not, however, with a description of placer mines that I propose to occupy your time, but with some notes on gold-bearing lodes.

Claims have been taken up for a distance of about twenty miles from the mouth of the creek. The nearest claim to Lillooet which I have examined is the "Talisman" about five miles up the river. Little work has been done at that point, but several quartz veins are exposed in the face of the bluffs. The enclosing rock is quartz schist. The direction of these veins is nearly E. and W. and their dip vertical. They are chiefly notable for the fact that they carry a considerable percentage of galena, pointing to the possibility of a belt of lead-bearing rocks existing here.

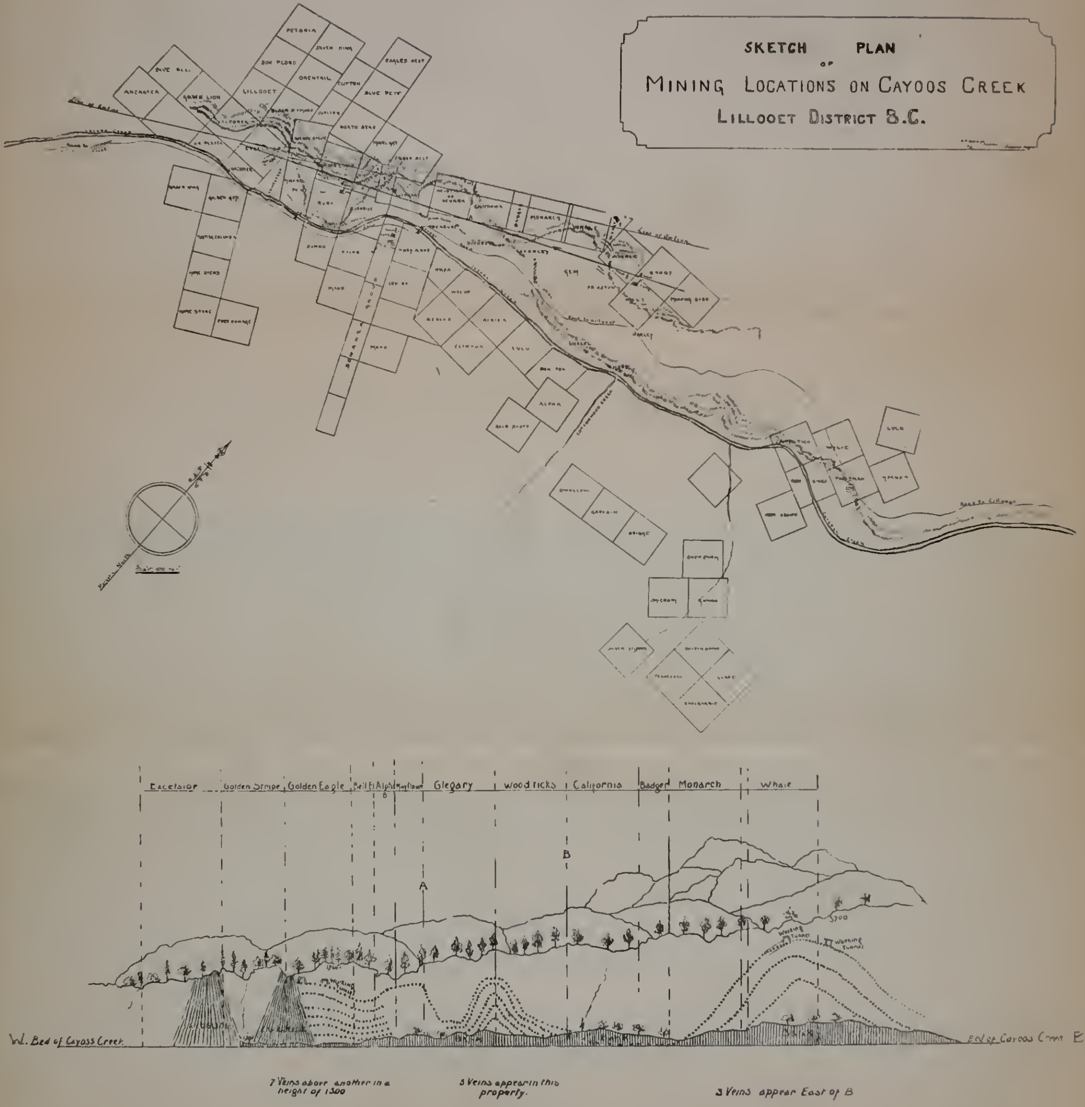
Proceeding further up the creek we come to the Ample property, which was worked by the Lillooet, Fraser River and Cariboo Co., Ltd. The principal development work done was to sink an incline shaft on a vein dipping to the west. This vein is partly composed of quartz, but contains also a great deal of slate carrying iron pyrites. In the end of a drift carried from this incline some good sections of anticlinal veins may be seen. In the great cliff which rises above the mouth of the shaft the outcrops of numerous other veins are visible. These works are at an altitude of 2,700 feet above the water. Before passing to a description of other properties, I may make some general remarks on the formation to be seen in the gorge.

In the sections visible in the cliffs numerous anticlinals may be seen, accompanied by their corresponding synclinals. The first anticlinal axis is that of the Ample, the second that of the "Bonanza," and others occur on the "Alphabelle," "Golden Eagle" and "Golden Stripe." There are perhaps two others—One between the "Ample" and "Bonanza," and another west of the "Excelsior." They might perhaps be viewed as subordinate depressions and elevations in the crown of one great anticlinal. A fine section of the third and fourth may be seen in the face of the bluff, which rises 1,000 feet from the water on the "Ruby," "Surprise" and "Alphabelle" claims· The general direction of these anticlinal axes appears to be S.S.E. and N.N.W. In the "Bonanza" group on the south side of the creek considerable work has been done by the Lillooet Gold Fields Company. The principal development was to run a tunnel 400 feet along the apex of one of the anticlinals on a body of slate and quartz carrying a little pyrites. This yields a little gold by assay. Its width is four feet. The incline shaft has been sunk on the east dip, which was filled with water at the time of my visit. The lode here dips 35 degrees to the east. A little below the mouth of the drift, which is 300 feet above the mouth of the stream, several small quartz veins occur, which carry some gold. There is another lode outcropping above the drift, which has a width of eight feet. This outcrop shows the east dip and also the apex of the saddle. The country rock at this point is all plumbaginous slate. Above



Sketch Plan : Mining Locations on Cayoos Creek, Lillooet District, B.C.

(Illustrating Mr. Moncton's paper.)



Sketch Plan : Mining Locations on Cayoos Creek, Lillooet District, B.C.
(Illustrating Mr. Moncton's paper.)

these works there has been a good deal of development work done on other lodes.

A little further west and north of the "Bonanza" are situated the works of the "Golden Cache" mine on a lode 1,300 feet above the water. A good section of the formation is given on the face of the bluff into which the level has been driven. The vein dips one in five to the east, and has been stripped for a length of 400 feet along the face. The quartz is about twenty feet thick at the mouth of the tunnel. Above the quartz is a wide seam of slate, which is reported to carry 6 dwts. gold per ton. Free gold may be seen plentifully sprinkled through the quartz, but the value of the material is difficult to guage in the writer's opinion without a mill test, as coarse gold is too irregularly distributed in quartz to test by assay without very careful sampling of a large quantity of the ore. It is proposed to build a mill on the property.

There has been a great deal of speculation in the shares of this company, so that its name is well known. Its discovery was accidental and has served to invest it with a halo of romance. A half-breed shot a goat, which fell over a precipice on what is now the "Golden Eagle." Climbing over to recover his spoil, he found it lying on a projecting ledge, and brought away with him some rocks, which he had broken off, as it contained shining specks. These were afterwards discovered to be gold. This occurred in May, 1896. Since that period a drift has been carried into the lode to a distance of seventy feet. A short distance above this drift the lode begins to dip to the west.

The vein reappears on the "Golden Stripe" and also on the "Alphabelle," which lies to the east; in which latter claim it is 15 feet thick. Although it is claimed by some that it is the same vein as that which appears in the "Excelsior" claim; this is not a certainty, but the two lodes resemble one another, and that on the "Excelsior" occurs where one would expect to find the continuation of the more famous lode. It outcrops on this claim for a length of 600 feet and has an average width of about six feet. On the west side of this claim some small lodes may be seen dipping to the east, which shows the existence of another synclinal at this point. Beyond this claim appears a dyke of eruptive rock which appears to run parallel to the anticlinal axes, and slate with quartz lodes in it occurs beyond this, but the writer has at present no knowledge of the rocks on the stream above this point.

So little has yet been done on this stream except in placer mining that it is too early to boast of its treasures, but as far as one can see there is good cause for believing that the lodes of Cayoosh Creek will make its name famous among mining camps, for it is not merely in the richness of one or two bonanzas that we have to put our trust, but the proved auriferous territory is at least ten miles wide, and the number of lodes underlying one another is very great ; their regularity is also a point in their favor. The thickness of the enclosing rocks is, so far as we know at present, 3,000 feet at least. It is probable that as the lodes are developed we shall find that the paystreaks have some common dip ; and perhaps that the apices of the saddles are the richest deposits. as in similar lodes in Australia, but this must be at present a matter of conjecture. The lodes appear to thin out towards the synclinals.

Notes on the Mining of Low Grade Gold Ore in Nova Scotia.

By Mr. C. F. Andrews, Country Harbour, N.S.

In view of the interest which at present is being awakened in the low grade gold ores of Nova Scotia, some personal observations in this line may not come amiss ; the purpose of this paper is, therefore, to give an outline of some personal experiences while manager of the Richardson Mine at Isaac's Harbor, in the Province of Nova Scotia.

The writer does not for a moment claim that all the methods adopted during this experience have been at all times as satisfactory as he could have wished. Circumstances often compel us, when we cannot obtain that which we would desire, to accept that which of things obtainable, comes the nearest to meeting our wishes.

The Richardson belt is composed of slate and quartz, between regular walls of whin. It is located in what is known as Stormont Gold District as the Gold Brook Anti-clinal (also called the Upper Seal Harbor Anti-clinal) the course of which is N. 62° W. and S. 62° E. ; and along which auriferous belts, lodes and drift have been discovered for a distance of three miles.

The Richardson belt was first discovered and worked on its south dip, where the average width was 11½ feet. In working west the belt narrowed down considerably. Eastward the belt turned in a northerly direction increased in width to 18 feet and lay very flat, the dip changing from south to east ; continuing, it swung around and ran westwardly, assuming a north dip and growing smaller again than on the turn.

The mill for crushing this ore is located about three hundred yards from the mine on the shore of a lake, from which the water supply is obtained. The ore is conveyed from the mine in cars running over steel rails, laid the greater part of the distance on trestle work. These cars are hauled by means of a steel cable, the power being taken from the mill. The total expense for haulage averages about three cents per ton, including renewals of cars, ropes, wheels, axles, &c.

When first started the mill was furnished with but fifteen stamps; a few months later the number was increased to twenty, and later to forty.

The following extracts from a report to the directors in June 1894 may be of interest, it being remembered that the mill then consisted of twenty stamps with hand breaking and feeding:

"At the mine three shafts have been sunk. The west shaft is not more than 30 feet deep and was put down mainly to test the length of the belt, which is here about seven feet wide.

"The middle shaft is down 100 feet, width of belt here from eight to fourteen feet. Tunnels and stopes are driven west from here 72 feet or to a point within eighteen feet of the west shaft."

The labor expenses here for drilling and blasting amounted to 26 cents per ton. The cost of dynamite per ton of ore sent to mill was 3½ cents.

"Tunnels and stopes are also driven east from here to connect with the east shaft, which is 108 feet deep. The southerly dip of the middle shaft is about 52° from the horizontal, that of the east shaft about 42°. East of the east shaft a tunnel has been driven on the belt 89 feet, the belt at this point having a width of 17½ feet. Here a bend of 70 to the northward takes place in the course of the belt. A tunnel has been driven here on the belt for a distance of 85 feet, the dip being 23° in an easterly direction, the width 18 feet."

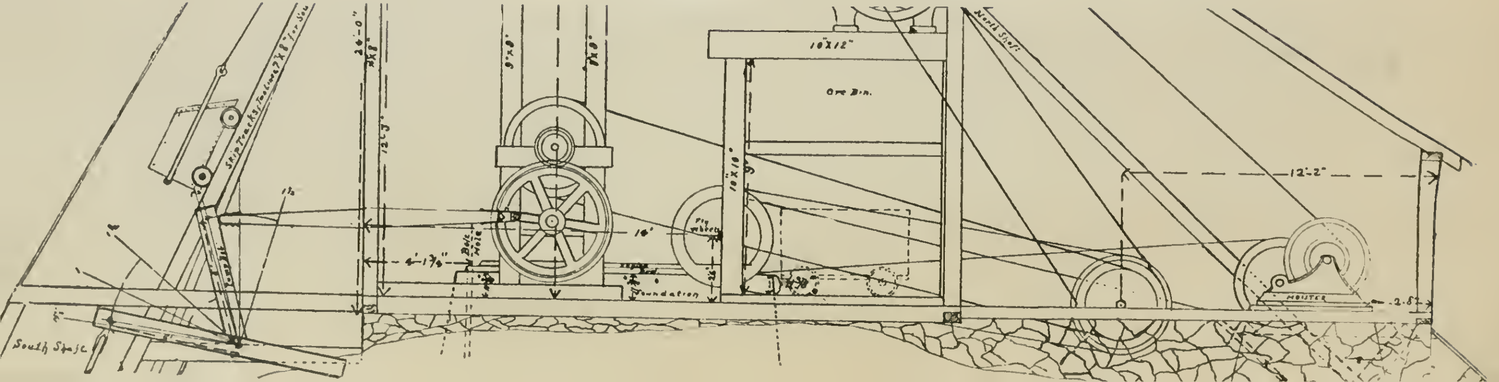
The total cost for mining, transporting to mill, and milling at this time was $2.90 per ton, including an allowance for total depreciation in value of plant in five years, and for taxes, insurance and all charges.

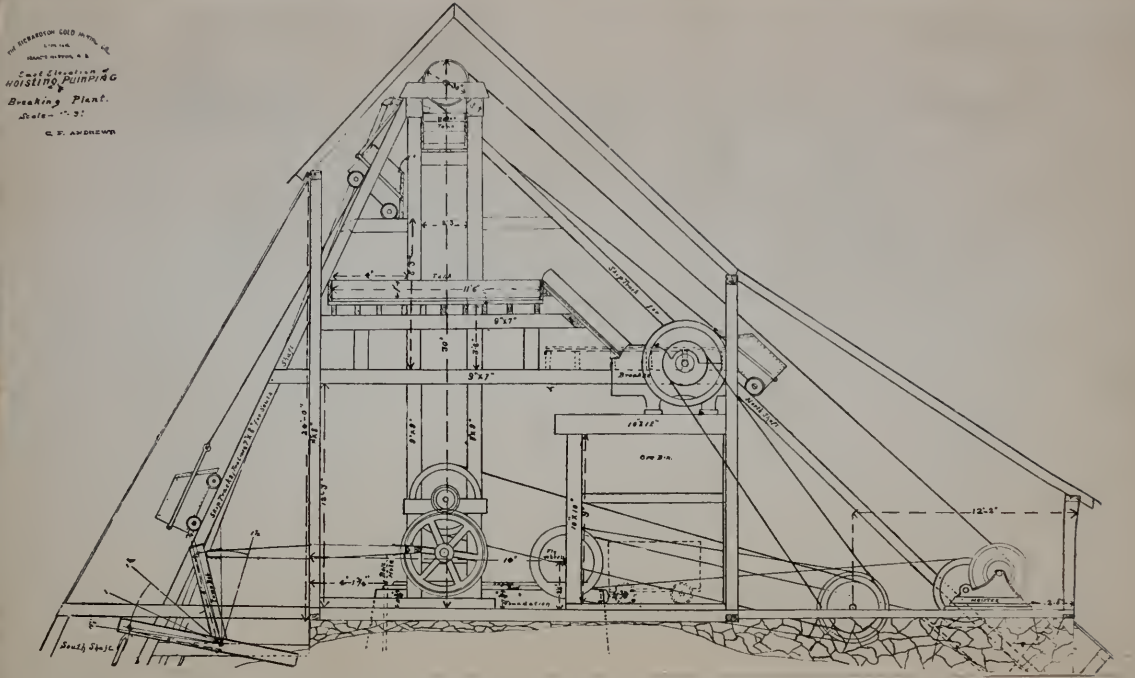
"The belt for the most part is composed of one large lode on the back-wall side varying in width from one to four feet, and a varying number of smaller lodes intermixed with slate. At places nearly the entire belt is quartz, and gold is sometimes found in the soft slate between the lodes. Not enough black or waste rock can be obtained below to load the scaffolds; and the walls have to be supported by leaving in blocks or pillars of ore."

It may be stated here that the underhand method of stoping was employed. In an attempt to use the overhand method it was found that

Hoisting, Pumping and Breaking Plant at the Richardson Gold Mine, Isaac's Harbor, Nova Scotia.

(Illustrating Mr. Andrew's paper on the Mining of Low Grade Gold Ores of Nova Scotia.)





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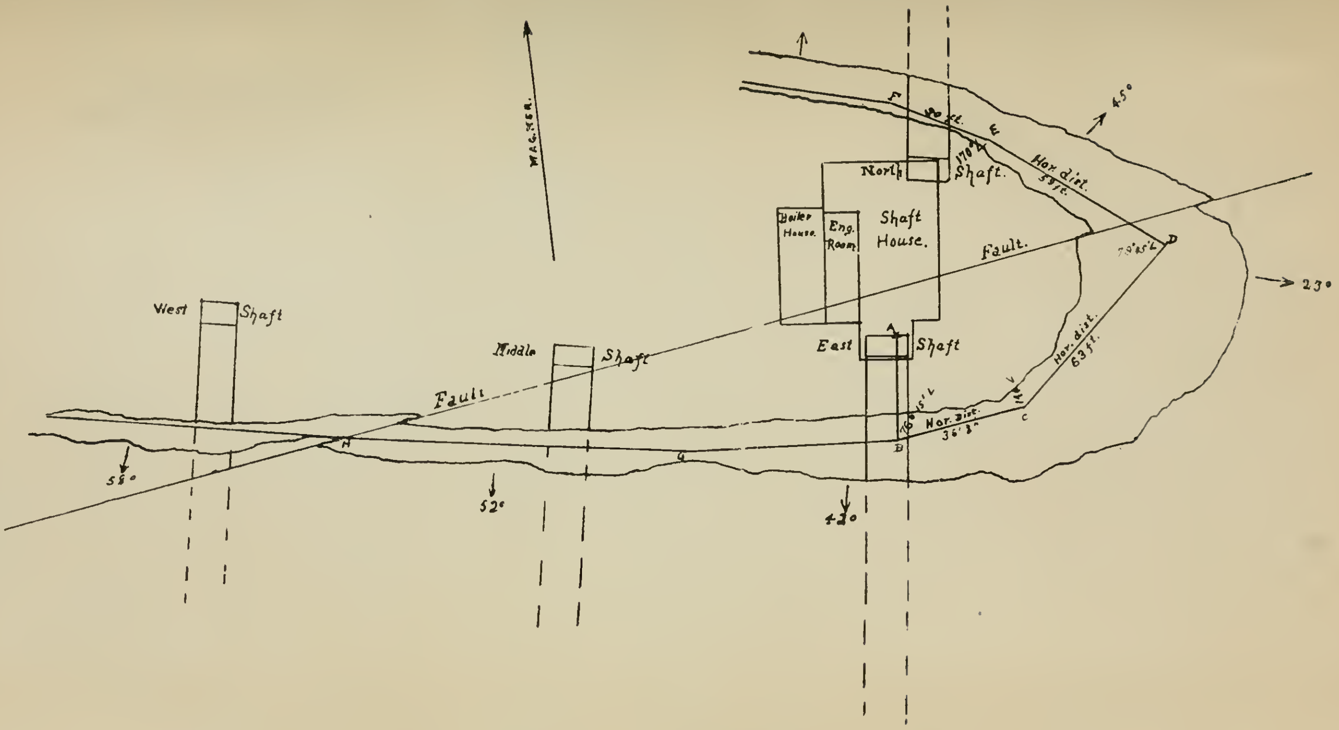
the slate between the veins of quartz was not firm and solid enough to hold the quartz in place overhead, and, consequently, large masses of rock were falling, making it dangerous to the miners beneath. I am of the opinion that at greater depth the slate becomes more firm and solid, and overhand stoping may be resorted to.

At this time hoisting was done from the east and middle shafts by a single cylinder engine, geared to a single friction-drum. The gear was so located that the rope could be shifted from one shaft to the other as occasion required. Wheelbarrows were used below ground as a means of transporting the ore to the shaft; and the ore was then hoisted in tubs to the surface, where it was washed, the waste rock thrown out, and the good ore shovelled into cars to be hauled to the mill.

Since then the belt has been followed farther west on the south dip; the east shaft, now the pump shaft sunk to a depth of 200 feet, and the belt driven and stoped on around the turn and followed west on the north dip. At the time of writing the belt produces more waste slate than in 1894.

The present plant consists of a hoisting, pumping and breaking gear, located on the apex of the semi-cone formed by the turn of the belt. Two shafts are worked from here, one on the south dip and one on the north. The bottoms of these shafts are about 250 feet apart, as measured on the belt around the turn; and as they are sunk this distance is of course increasing. At the surface they are 48 feet apart and converging towards each other. At a height of twenty-six feet above the surface the skip-tracks from each meet above the same deck head; and self dumping skips empty their loads beside the same rock-breaker. The "sump" at the deck-head into which the skips dump their loads is lined on the bottom with open-sand cast iron plates 7/8 inch thick, laid in 5/8 inch of cement. The ore is here thoroughly washed, the waste rock thrown into trolleys and run out on the dumps, and the good ore shovelled into a hopper which drops it between the jaws of a 9 x 15″ Blake breaker, from which it falls into a bin. Cars are run under the bins where the ore is allowed to fall into them. They are then run out on the main track and hauled by the wire cable to the mill, where they are dumped into a bin of 500 tons capacity. Thence the ore runs through shoots into the automatic feeders supplying the mortars. Copper plates are used inside these mortars. The surface dimensions of the outside plates are 12 ft. 6 in. x 4 ft. After passing over the outside plates and through mercury traps, the sand is discarded; no attempt being made at concentration.

In the mine every attention has been paid to working the rock to the greatest advantage. On account of the dip to the seams in the belt, it has been found that two drills working toward the west accomplish as much as three drills working towards the east. The works below are now supplied with a regular system of tracks over which the ore is conveyed in trolleys to the electric-lighted loading stages at the shafts. The south shaft, being the main shaft, is supplied with two skip tracks, one for the east and one for the west ore. The pump way is between the skip tracks and a little below them, or nearer the foot wall; thus being out of the way when ore is being loaded into the skips or timber being unloaded from them. The ladder-way is a compartment by itself cribbed up under the foot-wall cribbing, where it passes through the surface material, thus being out of the way of anything which could fall or injure a man. The slope of the shaft is so flat that no ladder is required to get at the pump. The north shaft has a skip-way in the east end and a ladder-way in the west end. The stopes were started from the east side of the south shaft and carried round to the north shaft—this rock being hoisted from the south shaft. The stopes are then continued west beyond the north shaft and the ore hoisted from the north shaft. Thus while ore has been hoisted from both shafts, the sinking and expenses connected therewith have been confined to one shaft. The number of hand.drills employed here to produce 2000 tons of crushing ore per month has never exceeded nine—two men to a drill. The surface plant at the mine consists of a 60 h.p. tubular boiler set in brick, and a 50 h. p. compound engine set on concrete foundation. Floors of engine and boiler rooms are of concrete. The hoisting machine is a double drum one, built especially by the Jenckes Machine Co., and laid on a concrete foundation The drums are side by side and of the usual cone-friction type; but instead of being driven by two small cylinders attached to it, its driving shaft is driven by belt and pulley



Plan showing Richardson Belt on East turn Gold Brook Anti-clinal ; also location of Shaft House.
Horizontal distance A to B, 30 ft. 8 in. Vertical distance A to B, 45 ft. 2 in.
C. D. E. F.—Points in Roof. Arrow Head—Direction of Dip.

from the compound engine; the same engine serving to drive the pumping gear and the rock breaker. The experience here has been that it is far more economical to drive everything from one compound engine than from a number of smaller ones, particularly where all machines are working continually day and night. The engineer fires his own boiler, and no extra attendance is required for the hoisting machines. Thus, the deckman when not engaged in bringing up or lowering skips, can wash and assort ores.

The water from the mine pump is discharged into a tank under a hatch in the peak of the roof. A hose from this serves for washing quartz or for fire purposes. The building is heated by exhaust steam from the engine, and like the mill, forge, workshop, stables, office, manager's house, etc., is lighted by electricity.

At the mill the plant consists of forty 850 lb. stamps, two return tubular boilers, one 16 x 42 Corliss engine, one Worthington duplex steam pump, 3½ inch suction and 3″ discharge, one Northey pump of the same description, a dynamo for lighting purposes and the hauling gear for bringing the ore from the mine. The forty stamps are arranged in a row, and the ore bin extends the full length of the batteries.

The ore cars enter the building at right angles to the ore bin, are turned on a table and run along the top of the bin to be dumped whereever the ore may be most required. One mortar is reserved for test purposes, the bin in front of it having a partition to keep the test ore separate from the regular ore.

The stamps drop 90 times per minute, and the mortars are arranged for very fine crushing. At times the gold is so fine as to be indiscernible to the naked eye. An instance of this was when 4,000 tons of ore were milled in which not a colour of gold was seen, but which, when cleaned up, gave a fair profit.

With this plant up to the time when my connection with the mine ceased, the total cost for mining and milling, including all charges, was $1.65 per ton

At the mill but one engineer was employed on each twelve hour shift, it being also his duty to attend to the dynamo and lights. It may be interesting to know that the electric light plant installed here paid for itself in one year in the saving of kerosene oil alone. When there is power to spare, as was the case here, and a large number of lights required, it cannot be too highly recommended, particularly around the plates of a mill.

The Richardson belt is very heavily mineralized; and there is great cause for regret that only the free gold is saved. The results of a careful and elaborate series of tests of the tailings from this mine made by Mr. F. H. Mason, are somewhat surprising to many who do not consider the auriferous ores of N.S. worth concentration. But facts speak loudly for themselves, and, much as we would like to have all of our ore free milling, this desire does not alter the refractory nature of some of it.

According to these tests made when the ore being crushed was of an unusually low grade, the average loss was 1 dwt. 18 gr. per ton. A sample of tailings from which all the concentrates were not extracted gave 1.3% of concentrates, which had an assay value of 1 oz. 10 dwt. 1 gr. per ton and still left a value of 1 dwt. per ton in the tailings. Another sample of tailings gave 6.3% of sandy concentrates, having an assay value of 1 oz. 1 dwt. 13 gr. per ton of concentrates. In neither sample was free gold or amalgam detected. The majority of the arsenical iron pyrites is contained in the slate; some samples of this slate assay very high. A chance sample gave the surprising result of 28 oz. 8 dwt. of gold to the ton of concentrates and yielded 30% of its total weight in concentrates. Two more assays of this slate gave concentrates valued respectively at 4 oz. 2 dwt. 8 grs. and 5 oz. 6 dwt. 12 grs. per standard ton of concentrates. As this slate contains so little free gold but a small portion of it is crushed.*

An analysis of clear concentrates taken from the sluices of the mill gave the following composition:—

Silica	2·65
Iron	35·63
Sulphur	16·80

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*Near the surface the slate is soft and partly decomposed, In this condition it yields considerable free gold when milled. As the depth increases the slate becomes harder, increasing perceptibly in bulk and in the quantity and qnality of its concentrates. Below a depth of about 100 feet it contains so little free gold that it is unprofitable as a free milling ore.

Arsenic	42·25
Copper	trace
Bismuth	"
Zinc	"
Mercury	nil

An assay of these concentrates gave gold 2 oz. 14 dwt. 21 gr. per ton. A chlorination test of these concentrates obtained an extraction of 97% of gold contained.

Being myself present when Mr. Mason made a great many of his tests and assays, and knowing the care that was taken with them, I cannot help feeling that it would be of general interest to those interested in gold mining in Nova Scotia to quote from Mr. Mason's report as follows :—

"It will be seen that you are losing a considerable amount of refractory gold in your tailings, you are dumping a considerable quantity of auriferous slate and leaving a further and larger quantity in the mine, and finally you have a large tailing dump, parts of which would pay handsomely for working over. I am satisfied that the gold you are losing in your tailings is practically all in the form of concentrates. In churning up an ore (often heavily charged with mispickel) in the battery, you must of necessity at times flour a certain quantity of mercury ; added to this, owing to the quantity of slate you are finally crushing, you have a very slimy tailings, consequently the floured mercury has little chance of re-settling, and small quantities are at times found to be carried away with your tailings. * * *

"With a view to saving the refractory gold, I would strongly advise you to put in Frue vanners, use a coarse mesh screen, and cut down discharge to one half what it is at present. I would also increase the stamping capacity by increasing the number of drops from ninety, at which you are now running your mill, to one hundred drops a minute. In advising you to to do this I wish to bring the following advantages you will gain to your notice :—

1. You will be able to crush the whole belt for, "your slate certainly contains refractory gold, and at times free milling gold. Your mine superintendant told me that he estimated that not more than one third of the rock broken underground was milled, so at the present

time you are paying for breaking rock 66°/₀ of which you have not in the past milled, nor would I advise you to mill it unless you put in concentrators, and crush it only coarsely for it is highly refractory, and if crushed finely it will flour mercury, and in that way probably carry away more gold than it would contribute to the amalgam in the battery or on the plates."

2. "You will decrease your mining expenses by more than one half; the only extra expense will be in hauling part of the slate, and in winding and hauling the remainder, while your output will be nearly three times what it is at present."

3. "I am of opinion that the slate will provide enough free gold to pay for the milling, in which case the concentrates will be all clear profit."

4. "You will dispense with the cost of picking the ore. I estimate that the cost of Frue vanners erected in Nova Scotia will be about $150.00 per stamp. To get satisfactory concentration it will also be necessary for you to put in mechanical sizers, (the cost of which is small) and feed the coarse tailings on to one set of vanners and the fine on to another set."

"Having obtained your concentrates, chlorination is undoubtedly the method by which they should be treated. The cost of such treatment in Nova Scotia will, I estimate, be about $4.00 per ton of concentrates. It will also be a matter for consideration whether the arsenic will be worth saving for two reasons, firstly, for its value, which is doubtful, and secondly, to prevent its contaminating pasture lands and consequently prevent claims against you for poisoning cattle."

"The cost of an eight or ten ton chlorination plant erected in Nova Scotia will be about $3,000, exclusive of building."

Up to the present time this property has produced 43,000 tons of ore, which goes to show that the mining of low grade ores in Nova Scotia at a reasonable cost per ton, has got beyond the experimental stages and is a reality. The handling of the refractory ores has yet to be experimented with, and from the appearance of nearly all the ore I have seen along the Gold Group anti-clinal I am of opinion that material for the experiment is not lacking.

The Gold-Bearing Deposits of the Eastern Townships of Quebec.

BY ROBERT CHALMERS, OF THE GEOLOGICAL SURVEY OF CANADA.

The area of the gold bearing region of the Eastern Townships of Quebec has been estimated at from 3,000 to 4,000 square miles.* It extends from Massawippi Lake on the south-west to Etchemin River on the north-east, and from the range of mountains nearest the St. Lawrence River, constituting the north-east prolongation of the Green Mountains into Canada, southward and eastward to the boundary line between the Province of Quebec and the United States. Only in certain parts of this area, however, does the precious metal really occur. Although fine particles of gold can be obtained in many places near the mountain ranges and along most of the river valleys, there are considerable tracts in the basin of Cambro-Silurian rocks where it has not been found.

The topographical and physical features of this region are well known having been described by Logan and Hunt in the earlier reports of the Geological Survey and by Ells in the later reports, ‡ and it seems unnecessary here to refer to them were it not that they have affected the distribution of the alluvial gold in some places. For the sake of clearer explanation, therefor, the main physical and geological outlines will be briefly recapitulated.

Commencing at the International boundary we have first a mountain range, constituting a natural divide, a portion of which consists of pre Cambrian schists and granites, namely from Emberton to Risborough, flanked by a belt of Cambrian slates. Next we find a wide undulating plain underlain by Cambro-Silurian slates crossing the whole region at a south-west and north-east direction in which granite mountains rise at intervals. To the north-west stretches a narrow broken range of pre-Cambrian, also flanked by Cambrian slates in places, known in the southern part as the Massawippi and Stoke Mountains, farther east is the Dudswell and St. Francis Mountains. Between this and the next range lies a narrow irregular band of Cambro-Silurian, and next is the wide, broken range of pre-Cambrian schists and eruptive rocks already referred to as the north-east extension of the Green Mountains into Canada. This borders the great plain of the St. Lawrence valley.

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*Report of Progress, Geol. Survey, Can. 1850—51 p. 6.

‡ Geology of Canada, 1863 pp. 1-4. Ann. Report Geol. Survey, Can. Vol. 2, 1886, pp. 30-32.

The belts of pre-Cambrian and Cambrian rocks are the highest while the Cambro-Silurian occupy, for the most part, basins between these. The great undulating plain or valley between the Stoke Mountains and the boundary line is occupied by thick deposits of boulder-clay and other superficial beds largely concealing the rocks from view. This seems to have been a depression into which sediments from the north-west and from the south have been carried from an early date in geological history.

GOLD IN THE PRE-CAMBRIAN.

The schists, gneisses, slates, etc. of the pre-Cambrian age being the oldest rocks here and the source of much of the material constituting the later rocks, the question arises whether they are not also the primary source of the gold of the region. And first it may be stated that it was to this series that Sir W. E. Logan and Dr. T. Sterry Hunt traced the gold of the Eastern Townships when the region was first examined by them.* Gold has been found in a number of places in these since the days of Logan and Hunt, and occurs at Massawippi Lake, also near Capelton and Sherbrooke in small quantities associated with copper ores; at Dudswell Mountain where a small quartz vein shows visible gold in small grains, also in a sort of conglomerate enclosing this vein. At Leeds and St. Sylvester it is also found associated with copper, likewise at Handkerchief settlement, etc. In all these places the gold is clearly derived from pre-Cambrian or associated rocks. Not only in the Mountains referred to does gold occur in this series, but rocks of similar age and character along the International boundry in Emberton, Chesham, Woburn, Clinton and eastward seem to have furnished it to the alluviums of that district. The Little Ditton River, along whose valley alluvial gold is found, takes its rise in or near the pre-Cambrian schists of the boundary, quite close to Prospect Hill, an intrusive mass of diorite. Across the boundary in New Hampshire its occurrence in rocks of this series is also recorded.

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*Geology of Canada, 1863, p. 519 and p. 739.

In the pre-Cambrian the gold appears to be associated with quartz and sulphides, chiefly iron and copper pyrites, in veins; but at Dudswell in a sort of conglomerate or arkose consisting chiefly of quartz felspar and talc, carrying sulphides.

GOLD IN THE CAMBRIAN AND CAMBRO-SILURIAN ROCKS.

Although the view has been generally held that the main sources of the alluvial gold of the Chaudiere valley, Ditton, etc. were in the Cambrian rocks they have not yet yielded gold in the matrix in workable quantities. Traces of gold in quartz veins have been found in these rocks in a considerable number of places, and milling work has been attempted in at least two localities in the Chaudiere district, namely at the Devil's Rapids and at Riviere du Loup, but the results, so far as I could learn, have not been encouraging. At the first mentioned place several veins containing quartz and sulphides occur which have, on assay, yielded gold.* In the Gilbert River valley gold has also been found in quartz veins † but as they are deeply buried beneath surface deposits their exploration was very difficult, and but little development work was attempted. At the falls of the Bras River a quartz vein which showed sulphide minerals gave on assay in the laboratory of the Geological Survey .117 of an ounce of gold to the ton.‡ "White garnetiferous rock near this place is also reported to contain visible grains of gold."** At Liniere, Risborough and Marlow the occurrence of gold in quartz veins has been shown by assays, while a specimen from a vein near Lake Megantic gave traces of gold to Dr. Hoffmann of the Geological Survey.* In addition to the foregoing a number of instances might be cited, showing that specimens from other parts of the area, assayed by reliable chemists and mineralogists, yielded the precious metal and that it occurs widely distributed in the Cambrian rocks as pointed out by Dr. Selwyn and Dr. Ells in official reports,† but as yet found only in very small quantities.

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* The Mineral Resources of Quebec; Annual Report Geol. Survey, Can. Vol. IV. 1888-89 p. 75 K.

† Ibid. pp. 74-75 K.

‡ Ibid. p. 76 K.

** Ibid. p. 76 K.

The amount of gold hitherto found in the matrix in these rocks being so insignificant, the view is sometimes expressed that no workable veins occur in the Eastern Townships. As, however, the alluviums have proved rich in some localities where the Cambrian and Cambro-Silurian rocks prevail, as for example in Gilbert River valley, Millstream, the lower part of River du Loup, Ditton, etc., and the source of this alluvial gold is held to be local by every competent mining geologist and miner who has examined the region, it follows that the rocks of the districts mentioned must contain gold in some hitherto undiscovered veins in greater quantities than have yet been met with. To account for its apparent scarcity in these at the present day it has been supposed that the upper and richer portions of the auriferous veins in the districts referred to have been eroded and thus furnished the gold to the alluviums from their destruction, while the lower and deeper parts of these veins, now examined and prospected, were less auriferous. There is no doubt that a great thickness of the strata, probably amounting to several hundred feet, has been denuded and swept away since the land rose above the sea in Silurian or Devonian times; but against this hypothesis is the fact that in the southern or upper part of this same Cambrian belt where it is overlapped by Cambro-Silurian rocks and consequently must have suffered less denudation, the veins carry no more gold, nor indeed as much as below. We are, therefore, forced to the conclusion, from this and other considerations, that the veins, or those portions of them which contain the most gold in the districts mentioned, have hitherto eluded discovery, being probably concealed by the deposits of boulder-clay and other materials which cover large portions of the surface to a great depth.

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*Ibid. p. 71 K.

† Report of Progress, Geological Survey, Can. 1870–71. Annual Report Geol. Sur. Can. 1886, p. 51-57 J.

QUARTZ VEINS; THEIR PROBABLE ORIGIN, ETC.

The quartz veins occurring in the Cambrian and Cambro-Silurian rocks, and perhaps those also met with in the older pre-Cambrian schists, exhibit differences and local characteristics which show that they cannot all have been produced under the same conditions, nor at the same geological period. The commonest of these consist mostly of white vitreous quartz, often without sulphides, though sometimes showing a selvage of pyrites. These, forming as they do, the hardest rocks, are often seen above the regular surface, and are apparently the prevailing kind in areas which have suffered least disturbance from intrusive diorites, diabases, etc., though also met with where the latter occur. So far as known these veins contain no gold, or if any, it is in very minute quantities. They are probably the oldest quartz veins of the region, though whether all were formed at the same period is problematical. They have been extensively prospected on the surface for the obvious reason that they occur everywhere in exposures.

Another set of quartz veins, of a less conspicuous character, found in some parts of the Eastern Townships, are often of a dull whitish or brownish colour from the presence of iron or other minerals with which they are charged in greater or less quantity. These are more limited in their distribution being apparently confined to the areas of metamorphic or intrusive rocks. It is in quartz veins of this kind that gold has been found in small quantities; but they are so seldom seen that our knowledge of their character and distribution is very limited. They seem, however, to be related in origin to the diorites and other intrusive rocks of certain parts of the region and to be of later age than the quartz veins first referred to. But even these may not all be of one age, that is, if dependent upon the intrusion of the igneous rocks; for Ells has shown that rocks of this kind occurring along the boundary line must have been erupted at an earlier date than those in the ranges nearer the St. Lawrence.*

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* Annual Report Geol. Survey, Can. Vol. II. 1886, p. 41 J.

As having some bearing on the origin of such auriferous quartz veins as were met with we may refer to Ells' reports and maps, well as to reports and papers by Dr. Selwyn, showing the distribution of the dioritic, diabasic and serpentine rocks of the Eastern Townships. On the maps Dr. Ellis has depicted an irregular belt of these intrusives traceable "from the Vermont boundary at Lake Memphremagog north-eastward for over a hundred miles, crossing the Chaudiere River and extending into the Townships of Cranbourne and Ware. * *This seems to be the great mineral-bearing belt of the Eastern Townships.* Within it are to be found the deposits of copper, of chromic iron, of asbestos, etc. and also the auriferous rocks so far as known, except those met with near the New Hampshire boundary. Now as regards the occurrence of gold in localities where these igneous rocks are found it may be asked is this merely a coincidence, or is it probable that these dioritic diabases, etc. have produced faults and fissures in the rocks into which gold in acid solutions has been brought up from below, as held by many geologists? Dr. Ells regards the auriferous veins there as related to the intrusives, more especially in the Chaudiere valley.† In Germany and the United States where investigations in regard to the origin of gold ores are being prosecuted with much zeal and ability similar views seem now to be revived. Von Kraatz in a recent paper on "The Formation of Gold Ore" says "if we look around for eruptive rocks in the famous gold districts we find that the principal fields of California, Australia and South Africa are cut in all directions by dykes of eruptive rocks of the diorite and diabase group. The inference is not far to seek that gold was present in the silicious waters which accompanied the eruption of these as well as other deep seated or surface flows, and that it was precipitated in the adjacent rocks by the agency of sulphides which already existed there or were sublimed by the eruptions." And further, "it is certainly not by chance that rocks of the diorite group occur in close relation with gold districts in regions far removed from each other; and it is on the other hand altogether likely that it is this very class of rocks whose presence serves as the invariable associate and *raison d'etre* of gold deposits.*

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* Annual Report Geol. Survey, Can. Vol. 11, 1886 p. 39 J.

† Canadian Mining Review, January, 1896, p. 15.

In the Chaudiere district diorite bosses occur on both sides of the river, especially within the Cambrian area, from Beauce Junction to St. George. They are abundantly developed near St. Francis and the Devil's Rapids, also in the Gilbert River valley, many more óccurring there than could be shown on the published Geological map of the scale of 4 miles to one inch. They were also observed in Famine River valley. These eruptives seem to have produced marked changes in the physical features of the district and a dislocation in the channel of the Chaudiere River, from which the Devil's Rapids originated. Just what relation the gold ores and the quartz veins bear to the eruptive rocks, or whether they really have any, has not been determined in this locality, as exploration has been limited in this respect, except such as was carried on by Mr. Wm. Lockwood and no pits or shafts were open at the time of my examination. Mr. Lockwood worked out the Geological structure of the Chaudiere Valley at the Devil's Rapids in considerable detail and traced several faults and a number of quartz veins there and to the north-west. He also informs me that while carrying on underground work in the alluviums of Gilbert River, he attempted the exploration of at least two of these auriferous quartz veins, following them for some distance, but was unable to continue the work.

The fact of alluvial gold being most abundant where these intrusive diorites are most common here may or may not have the relation referred to by Von Kraatz; we certainly require further evidence on this point. There is a lack of knowledge concerning quartz veins in general, and until the local structure of the gold-bearing districts is worked out in detail and the veins followed for some distance in a horizontal direction, as well as opened in some places vertically, nothing but hypotheses can be offered regarding the mode of occurrence of the gold in them, or any analogy drawn between them and the gold bearing rocks of other countries.

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* American Geologist, August 1896. Translation by H. V. Winchell.

The further investigation and exploration of the quartz veins of the Eastern Townships should, it seems to me, be in the direction of testing those in which traces of gold are actually known to occur, and by this means possibly reaching richer portions of them. There seems little reason to doubt that if careful development work were carried on in this way, especially in the Chaudiere, Dudswell and Ditton areas, gold in paying quantities might be found in them.

GOLD IN THE ALLUVIUMS.

The comparative abundance of gold in the alluviums of several portions of the Eastern Townships, has been unfavourable to explorations in regard to searching for gold in the matrix. For, when a local miner can get a dollar's worth of gold a day more or less, with the chances of picking up a good sized nugget now and then simply by the ordinary processes of digging and washing, and with no further outlay than what it costs to buy a pick, shovel and rocker, he is very likely to be indifferent as to the expensive and uncertain exploration of quartz reefs. In discussions which have taken place regarding the gold mining capabilities of the region, and more especially of the Chaudiere district, it is often remarked that work has been carried on in a haphazard and unskilful manner there, but these statements seem to be only partially correct. When we consider that quite a number of mining geologists, engineers and experts have examined and reported on the alluvial gold mines of the Chaudiere and other parts of the region from time to time since 1850, it becomes evident that they cannot have suffered to any great extent from lack of skilful investigation and study. The capital employed in developing and working these mines has also, in the aggregate, been very large, and all the parties who have invested cannot be charged with a desire simply to squander money. Nevertheless, the successful ones have been few, while the failures foot up a pretty large total. Some of the causes for this condition of things are not far to seek and are apparent to any one who will visit the district, especially the Chaudiere valley, and enquire into gold mining matters for himself; but it would be an invidious task for me to point them out. My object at present is to refer more particularly to the difficulties attending alluvial gold mining in the Eastern Townships, especially in the district last mentioned—difficulties due to the position in which the superficial deposits now lie, to their peculiar character, and to the irregular and sporadic manner in which the gold has been distributed in them.

The general succession of the superficial deposits in the districts in which alluvial gold occurs may be thus succinctly stated in descending order: (1) Surface gravel and sand, often forming a thick, stratified deposit in river valleys, and containing fine gold; (2) boulder-clay, including an interglacial deposit in some places; (3) Stratified clay and sand in alternate beds, the "pipe-clay" of the miners and the "quicksands." These two are not known to contain more than fine colours of gold. (4) Stratified gravel which in gold-bearing districts is usually auriferous, often rusty or oxidized. (5) Rotten rock in some places (saprolities);* (6) rock surface, often containing gold in the seams and crevices. In the Ditton and Dudswell gold districts the quicksands have not yet been met with in any quantity, but the workings in these places are, so far, only in the shallow beds. In the Chaudiere area, however, they are developed in great bulk and together with the overlying boulder-clays form one of the greatest obstacles to successful and profitable gold mining in the deeper workings.

Into the history of the causes which produced these quicksands and the boulder-clay it is unnecessary to enter. The former belong to the Tertiary or preceding ages, and were deposited in a period of slack drainage brought on either by differential changes of level in the land, or by a damming of the rivers by glacier-ice or both. Succeeding this was the glacial period when ice covered the country and when the heavy beds of boulder-clay were laid down from 75 to 100 feet thick in some places. A shaft sunk on the west side of the Chaudiere, opposite Jersey Mills, is 77½ feet deep, or nearly 60 feet below the present level of the river, and the bottom of the boulder-clay was not reached. This shaft shows that the old river bed in this vicinity is lower than the ledges over which the river now flows at the Devil's Rapids. Another shaft 70 feet deep was sunk by Mr. W. P. Lockwood just above the Devil's Rapids. These shafts show the difficulties to be encountered in deep alluvial mining, at least in the main Chaudiere Valley below the confluence of the Du Loup.

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* This a term applied by Dr. G. F. Becker, of the U.S. Geological Survey, to the "rotten rock" in the gold fields of the Southern Appalachians (U.S. Geol. Survey, sixteenth Annual Report, 1894-95, p. 289.

The superficial deposits of the Eastern Township it thus appears are differently constituted from those of other known alluvial gold mining regions except it may be British Columbia. Below the boulder-clay and quicksands the beds are practically the same there as in other countries, but these usually mantle and conceal the alluviums and are apparently greater hindrances to mining than even the lava beds of Australia or California. Either in shafting or drifting they constitute the great drawback to the exploitation of deep mines in Beauce County. When to this is added the fact that the distribution of the gold in the gravels beneath these is sporadic and that only in certain parts of the district is it likely to occur in sufficient quantities to be profitably worked under the most advantageous condition, the precarious and uncertain nature of alluvial gold mining there becomes apparent.

Gold mining in this region has hitherto consisted largely in the exploitation and washing of the gravels in the shallower beds, and little has been attempted in the deeper portions, or where the auriferous deposits lie below the level of the present rivers, except in the Gilbert River valley in which Mr. Wm. P. Lockwood informs me he mined these deposits at a depth of 70 or 80 feet lower than the present stream bed. The future development of alluvial mining seems, nevertheless, to lie in the direction of working these deep-lying beds, especially in the valley of the Chaudiere and the lower part of the main tributaries. Though great local difficulties present themselves in attempting to exploit these in the particular localities mentioned, yet they would seem to offer an inviting and ample field for the exercise of the genius of the mining engineer or practical miner. While the prevailing opinion in regard to these deposits is that they are rich in gold, it is evident that their auriferous character should be sufficiently tested before development work is attempted. The great thickness of deposits to be penetrated by shafts or tunnels before the auriferous gravels can be reach has especially to be borne in mind. If these were known to be equally rich, or to have the same value throughout, then openings might be started in the most accessible and favourable locations at the surface ; but these auriferous beds do not seem to be all equally rich, and some portions will likely be found not to contain gold in paying quantities. The necessity of exploring and testing them before commencing work is therefore evident. To effect this it would seems that boring machines are absolutely necessary, especially in the Chaudiere and Ditton districts. With appliances of this kind the position of the old river channels in which the alluvial gold is supposed to have been concentrated, could be located at much less expense and in much less time than by shafts or tunnels, the thickness, and probably to some extent, the paying character, of the auriferous beds beneath made known, and the advantages or disadvantages with respect to drainage ascertained before commencing actual mining operations.

Preliminary exploration of this kind would, moreover, seem to be necessary to prove the gold content and show, if possible, whether it will warrant the expenditure required to work the deep-seated auriferous deposits. Some portions of them, it is evident from the great expense attending their exploitation, will require to be very rich in gold in order that they may be profitably mined, while in other places there does not seem, as already stated, to be sufficient gold to prove remunerative under the most favorable conditions for extracting it. A thorough study of the deposits, and of the mode of occurrence of the gold in them, from actual observation, are desirable, and in this investigation the experience of the old miners who have spent a large portion of their lives and in some cases considerable sums of money, might be utilized to good advantage.

Notwithstanding the difficulties and uncertainties of alluvial mining just referred to the writer considers the prospects not at all discouraging, and regards the region on the whole, as offering inducements to miners and capitalists equal, in some respects at least, to other gold minin districts more favorably spoken of. Knowledge and skill are, however, absolutely necessary to success, and these if acquired from a study of the peculiar local phenomena found in the region itself, will, I venture to add, prove to be the most useful.

In this short paper little has been offered beyond a few facts and inferences touching the questions brought forward, and I have, therefore, to apologize for its incomplete character. An official report is now in course of preparation in which fuller details will be given.

DISCUSSION.

Mr. W. P. Lockwood—Long ago I came to the conclusion that the gold fields of the Province of Quebec, including the Chaudiere division, were less known than those of any other part of the Dominion. I first visited the Beauce district in 1865. I returned in 1866-67, when I had the pleasure of meeting Professor H. Y. Hind, from whom I obtained most valuable information and assistance. He was making a survey of the Delery Company's property. We were at that company's house at the Devil's Rapids for many weeks. At that time about 150 miners were working on the Gilbert river, and were making from $4 to $8 a day each. I considered that was a very satisfactory showing, and it induced me to make further inquiries. The only appliances used were the pan, rocker, long tom and some short sluices, and I think it was very enterprising for these people with their small means to make a tunnel 1800 feet long, which drained a large portion of the ground and enabled the miners to sink close alongside their ; shafts and pits, leaving dividing wall between the chains.

In a few years these miners took out from ten acres of shallow ground three quarters of a million of dollars in gold. Many nuggets were found from 15 to 51½ ounces each. Twenty-six feet was the deepest ground reached in these shafts.

I found the whole of the people dissatisfied with the existing state of affairs. The owners of the mining rights were the Delery Co. The owners of the land had no right to the precious metals ; yet both these owners had to be arranged with before the miners could enter on the ground and work for gold.

Professor A. Michel says in his report of February 6th, 1866: "It seems then to be established that the rich deposit of the Gilbert River has for its upper or northern limit lot 21 of the concession Delery, beyond which point, so far as examined, the alluvions, although more or less auriferous, are not workable. The irregularity in the distribution of gold in the gravel is noticeable throughout the region, but appears more marked on the Gilbert than elsewhere."

Again at page 9 he says: "The rich alluvions of the Gilbert, which were worked in 1863 and 1864 with considerable success, are now considered to be exhausted." Mr. Michel sunk a number of shafts 8 to 12 feet deep along the banks of the river for about a mile. He got colors of gold in places, but no deposit of any value. In the face of this report and adverse public opinion, I bought mining rights on a piece of ground 100 x 200 feet. Some legal trouble arising, I gave it up to Mr. Nash, and saw 16 ounces of gold taken from the bottom of a four foot shaft on this property.

After giving up this 200 feet, I bought from the Delery Co. a piece of ground covering nine acres. It was laid out in miner's claims 100 x 50 feet. My first shaft was on claim 12. It was 69 feet deep I then ran a drift about 150 feet to cross what I thought might be the "lead." My next shaft was 85 feet deep, and about 200 feet further south. In my old mining diary under the date September, 1869, I find the following entry: "Wrote Mr. Robinson (M.E., London), fully respecting tunneling into the hill on lot 75, first range N.E., some distance below the Grist Mill, and arranged to work up from that point by 'bed rock flume,' if possible."

On the 25th September: "Commenced sluicing from a new shaft, and got one nugget weighing 5 ozs., 6 dwts. 2 grs., and in all, the first day, 12 ozs., 7 dwts., 4 grs. of good coarse gold."

"Found several pieces of a semi-fossilized tree in the sand at top of drift laying on the gravel, which is 85 feet from the surface."

At this point I opened what is undoubtedly a true old river channel with a current of water running through it and a bed of auriferous gravel resting on the bed rock for a distance of more than six miles. This is the first ancient river channel discovered in Canada, that holds auriferous gravel along its entire course, and I do not know that any other rivers have been fairly explored and tested for gold in this province.

From 1869 to 1876, seven years, no one except myself carried on any mining operations in the Chaudiere mining district. I alone was mining. I employed from 75 to 150 men and acquired from the Delery Co. sections 3, 4 and 7 about 16000 arpents of mining lands.

As soon as the mining became deep and pumps had to be used many of the working miners left the district and most of those living in the district worked for me many years.

The result of my explorations was highly satisfactory. I took out from prospecting shafts on miners claims about 1400 oz. and people to whom I gave a lease about 500 oz. of gold I carried on operations in various parts of the Seigniory and opened the old River Channel on lots 13, 14, 15, Delery, and on lots 13, 12, 11, 10, 8, 7, St. Charles Concession, with satisfactory results, exploring and working down to the Chaudiere River; 3½ miles. In myreport of August, 1870, I stated:

" During the last five years I have observed closely all the work done, and have not seen one intelligent attempt made to obtain a knowledge of the nature and origin of the rich alluvion deposits, and no one except myself has done anything to establish the fact, that the alluvions have their origin in the local reefs, or that we have a distinct system of old river channels, at a considerably lower level than the present ones, their gold bearing gravel in all cases being derived from the local rocks. The average yield of gold from our prospecting shafts is $43,000 per acre; cost of working $15.000.

In 1876 and 1877 some of my men who had worked in the various shafts and knew the position of the lead and value of the gold deposit at these places, took possession of our ground on lots 11 and 12; they obtained licenses to work for gold from the Quebec Government, by whose illegal action they were maintained in possession until December 1884, when the Courts declared our title good and valid, and the attempt of the government to annul the letters patent of 1846 entirely failed. The account of the gold extracted and taken from us will show the monstrous injustice perpetrated and some portion of the enormous loss sustained, all my mining works plant and buildings were destroyed and confidence in the enterprise has never been re-established.

I have had mining Engineers from Nevada and California, South America, Australia, England and New York to examine the property and besides these I have consulted some of the best known mining experts.

In this district hydraulic mining and tunneling for bed rock flume are not practicable methods ; the upper gravel beds cannot be worked to advantage, even with the modern hydraulic methods or steam shovel dredgers and appliances. Except on the Gilbert scarcely anything has been done to test the extent of the gold-bearing gravels, all the flats, creeks, and gulches together with such streams as the des Plant, Mill, Bras, Bolduc, Famine and duLoup as well as the great valley of the Chaudiere River, offer great inducements to practical men who have a fair amount of capital. These old channels will be found near the surface at their source and at least 150 feet deeper than the Chaudiere River when they reach it.

The quartz reefs are undoubtedly auriferous, from many of them I have taken fine gold by mechanical assay ; not one of these reefs has been opened or examined except by sinking on the exposed outcrops, these are extremely rare and one or two outcrops are the most that can be seen if their course is followed for miles ; these exposures are invariably in hard country rock and not more than ten or twenty feet along the vein is seen at the surface ; details respecting most of them are given in a full report I made for them government in 1886. It is my intention to condense and revise this report shortly, as I have accumulated many valuable facts relating to several of the quartz reefs. Some of them I am quite sure will be worked to great advantage. Although my undoubted property and gold has been most outrageously confiscated and given to others, and I am forced out of the country, I shall be glad if I can do anything towards developing the enormous resources of the Chaudiere Gold Fields which since my last work on Lot 13, concession Delery in 1893 are again lying dormant.

COPY OF SWORN RETURNS OF GOLD EXTRACTED FROM THE PROPERTY OF THE CANADA GOLD CO. FROM 1ST JULY 1880.

				Oz.	Dwt.	Grs.	
St. CHARLES,	Lot	12	McArthur Bros............	458	16		
	"	11	La Santa Anna...........	29	10	5	
	"	10, 11	Thos. Richards.........	1625	13	2	
DELERY,	"	12	Grenville M. Co. of Ontario.	41	7	10	
	"	13	Clarence Gold Mining Co...	1311	10	9	
St. CHARLES,	"	12	Geo. Sherrien & Co.......	60	7	14	
DELERY,	"	13	Cameron, Gibson and King.	56	6	20	
	"	13	McDonald, Powers & Potvin	17	10		tailings
	"	14	Chas. Lionais & Co.......	27	6	20	
	"	14	Beauce M. and Milling Co..	324	1	2	
	"	15	John McRae.............	45	7	21	
	"	16	East Branch Co	12	16	12	
	"	16	Beresbe & Co............	3	19	15	
	"	17	Chaudiere Mining Co		17	10	
	"	17, 18	Sands & Spalding.......	4	4	23	
	"	18	Victoria Co..............	2	9	19	
	"	20	Jas. Reed...............	3	8	14	
	"	12, 13	Miscerim Dion.........	3	16		tailings
	"	13	Hugh McGillis	4	11	10	
	"	11	Jean Lefebre............	1	4	12	
	"	11	A. Walker...............	3	4	2	
	"	12, 13	E. Fenton...........	24	7		tailings
DEVIL'S RAPIDS	Lot		L. Blanchet	1	1		
ST. CHARLES	"	11	Gilbert Tomlinson	118	0	5	
	"	11	J. Forgie.................	114	14	11	
	"	11, 12	St. Onge & Co.........	1001	13	13	
	"	11	Powers, Black & Co.......	1	13	6	tailings
DELERY	"	13	V. Coupal & Co...........	10	3	20	
	"	18	L. Gendreau..............	22	14	1	
1ST. RANGE	"		John McNicholl..........	4			
	"		Billy Poulin & Co.........	8	0	6	
ST. CHARLES	"	12	Canada Gold Co..........	3306	14	21	
			Gold dust and nuggets bought by Lachance, Renaud and Potvin	284	5		
				8912	14	15	
				$164,616.00			

Certified 8th June, 1887,

H. J. J. DESCHESNEY, I. G. M. D.

Gold Quartz Mining in Canada and Victoria, Australia.

By Dr. A. R. Selwyn, C.M.G., Ottawa.

We have latterly heard and read so much about gold in Canada and the marvellous richness of Canadian gold mines, that I have thought a few facts and comparisons respecting gold and gold mining in Canada and Victoria might be welcome, and serve to dispel some illusory ideas on the subject. It is said that "comparisons are odious," but then in these days of universal "booming" truth to many persons who have "axes to grind" or schemes to work, is still more odious and unpopular, but that is no reason for telling that most pernicious and meanest of lies, half the truth.

You are all so familiar with the history of gold discovery and development in Canada that it seems needless to do more than refer to a few dates and documents respecting it. In Quebec its existence was first made known by Lieut. Baddeley, R.E., in 1835—sixty years ago. In chap. XVII., pp. 518-20, and in chap. XXI., pp. 739-40 of the Geology of Canada, 1863, all that was known of its distribution and development up to that date is to be found, and on pages 47 to 90 of the Geological Survey Report 1863-66 are to be found the first records of its development. Then as now extravagant figures and estimates were indulged in. About the same time, 1860, auriferous quartz veins were discovered in Nova Scotia, and in 1865 there appear to have been 24,867 oz. raised : in 1866, 24,162 oz. ; in 1867, 27,583 oz., or equal to 76,612 oz. in the three years. From 1869 to 1874 the average production in Nova Scotia was 18,987 oz. The deepest mine is now only about seven hnndred feet, and it seems to me strange that better results have not been attained.

In 1871 I examined and reported on the Nova Scotia gold mines, and I saw that the geological conditions there were almost precisely like those in Victoria, where the deepest mine is now 3,000 feet, and it strikes me as strange and not very creditable to the mining enterprise of Nova Scotia that even now the average production and the depth to to which the mines have been worked, has made so little progress. In 1858 I stated my opinion as regards the gold mines in Victoria (see correspondence appended). I hold the same opinion with regard to Nova Scotia, and I think work should be undertaken in order to see whether that opinion is correct, and some deep shafts should be sunk to test it. The veins in Nova Scotia are not as abundant as they are in Victoria, but are quite as rich if not richer.

In Victoria the truth of my opinion has been proved by shafts two thousand to three thousand feet deep now being worked.

As regards alluvial mines also I think proper investigation should be made. The lakes and lagoons in Nova Scotia represent and,—except the absence of water,—are quite like the auriferous flats and gullys in Victoria from which millions of ounces of gold have been extracted. That no such deposits should exist in the depressions between the hills in Nova Scotia seems incredible.

The first record of the discovery of gold in Ontario is in the Geological Report, 1866-69, pages 165-71. This was the well known Richardson mine, and the first mine worked for gold in Ontario. Nothing was known about gold or its distribution in Western Ontario till about the time of the building of the Dawson road and the endeavors of the Geological Survey to trace out and define the various belts of Huronian strata after having recognized their importance as the mineral bearing series of Canada, and the further recognition that these belts were not Laurentian but Huronian, and the same as the lower copper bearing group of Sir Wm. Logan ; consequently that they would probably be found to present the same mineral character.

Of the actual yield of gold from these belts in Ontario to date I have no record, but in the Geological Survey Report, 1872-73, p. 107, the "New Gold Field" of Shebandowan Lake is described. Prior to 1885 I find the names of six gold mines that were then working in the Lake of the Woods and Rainy River district. These were as under : Manitoba Consolidated, Pine Portage, Canada Mining Company, Lake of the Woods, Keewatin Mine and Argyle Mine. They were then working, but now I find that not one of them appears in Mr. Bell's admirable Index to Mining Companies in the Mining Manual for 1894, and there is no record of their history other than that above referred to. The result of the work done on them would be interesting, especially if accompanied by a correct debtor and creditor account. All these mines, I may say, were well examined and described in the Geological Survey Report, pages 5 to 20, in 1884.

It seems unlikely that the history of gold mining in Canada will differ from what it has been in other countries, and under corresponding geological conditions.

In British Columbia gold was first discovered in 1858, and as we all know has been more or less profitably worked ever since. The total production from 1858 to 1894 has fluctuated from 70,000 oz. in 1858 up to 3,913,563 ozs. in 1863, and down to 456,066 oz. in 1894, the total of the thirty years being 3,614,989 oz. Thus the report shows in every country a steady, though gradual and fluctuating decline in yield. What the effect of the opening of new ground, better mechanical and chemical methods and appliances may be, we have yet to learn, but it is not likely that in the next thirty years an equal amount of gold produce will ever again be recorded within the same area ; though the advent and vigorous prosecution of vein mining in British Columbia will have a potent influence in that direction.

In the last copy of the the MINING REVIEW I see a statement that " It is out of place to attempt a comparison between the gold fields of Ontario and those of any other province or country." Why, does not appear, and I certainly cannot endorse the statement. It is only by knowing and comparing with results elsewhere that we can gain a true and accurate knowledge and appreciation of our own results and possibilities. In any case, comparisons are always educationally useful, if truthfully stated, carefully considered and intelligently applied. All circumstances duly considered, I hold that Australasia is the richest mineral country in the world, and especially so in regard to gold. I find the following record of produce for quinquennial periods from 1851 to 1893:

	Ounces.
Australasia	92,648,000
United States	89,353,000

This probably includes Canada, but amply proves—area, population and age considered—that Australasia is really the richest gold country in the world, unless developments in Africa place it in the first rank. You will see that Australasia has actually exceeded the whole of America in the quantity of gold produced. The area of Australasia is about the same as Canada; the population is also about the same, about four and a half millions or not quite five millions, and the population of the richest of all the Australian gold fields (Victoria) is only a little over one million—it may be 1,500,000—thus when we consider relative area and population, I do not think that America (with her population of sixty millions) has anything to be proud of, or can claim to be the richest gold field in the known world.

The idea seems prevalent that Canada is an exceptionally rich mining country. This I hold to be a fallacy. Canada's resources in minerals are large, and are capable and worthy of better development. It is, however, in the last degree unlikely that it can ever vie in gold produce with the smallest province of Australasia. Canada is essentially an agricultural and pastoral country, and on the vigorous development of these industries will her future prosperity mainly depend. The produce from these is always an increasing one, while that from gold mining is always diminishing and must eventually terminate. Of the three kingdoms of nature—the mineral, the vegetable and the animal—only one is incapable of reproduction, and therefore mortal. The animal and vegetable kingdoms are always re-producing; and therefore always increasing in quantity and value.

The chief and greatest value of gold and gold mines—especially in a new and unexplored country requiring people to work and develop its re-productive resources,—lies in its power to attract such people rapidly and in such numbers as no other inducement will succeed in accomplishing, and therefore every Canadian must wish the utmost success to the efforts now being made to develop the gold mining industry in the Dominion, but not by the plan of the modern miner who, unlike the ancient miner, begins by opening a broker's office on a leading thoroughfare instead of a tunnel in a mineralized hillside. I quote from the Canadian MINING REVIEW for January (page 4): "It is sound advice that those who cannot afford to lose should leave mining investments severely alone." Canada in eight years has not produced as much gold as Victoria has produced often in a single year. For instance, in 1894, Victoria produced 673,680 ounces, while from 1886 to 1893 Canada only produced 496,896 ounces. As regards the gold produce of Victoria I can give you the figure for the quinquennial periods from 1851 to 1890 to show what I speak of, the diminution of gold production. The figures are as follows:

	Ounces.
1851 to 1855	11,218,772
1856 to 1860	12,712,946
1861 to 1866	8,341,464
1866 to 1870	7,105,820
1871 to 1875	6,130,962
1876 to 1880	4,136,753
1881 to 1885	4,081,269
1886 to 1890	3,111,373
1887	617,751
1888	625,026
1889	614,839
1890	588,561
1891	576,400
1892	654,456
1893	671,126

You will see by these figures that there was a gradual decline from eleven million ounces from 1851 to 1855 down to three million ounces during the period of 1886 to 1890.

In 1858, I stated what I considered to be the prospects of gold mining in Victoria. Anyone who takes an interest in the future of quartz veins in Canada can read this correspondence. The important point here now in Canada is the same question. The deepest mines in Nova Scotia, as already stated have not yet exceeded seven hundred feet, and, I believe, not five hundred in Ontario, while I could name you ten mines in Victoria whose depth runs from 2,333 to 3,000 feet. Now in view of the relative depths of quartz mining in Victoria and in Canada, and the recorded yield of the quartz, the quantities crushed and the depths attained are not complimentary to the enterprise and energy of the Canadian miner. As regard Nova Scotia at least, the conditions, as already stated, are precisely like those of Victoria, and there seems no reason why the veins in Nova Scotia should not be worked to depths as great as those of Victoria. To the depths already reached the average richness of the quartz crushed has been greater than that of Victoria, and the returns should certainly be much greater than they have been.

In British Columbia, unlike Nova Scotia, Quebec and Ontario, nature has given you easy access to depths of thousands of feet beneath the surface, and the facilities for mining and mineral development there are far greater than they ever can be in the other provinces.

I do not think I have anything further to add to these remarks. Perhaps some people will consider them very deprecatory of Canada and Canada's resources, but I do not look upon them in that light at all. I simply regard them as a statement of the truth, and I have no wish to encourage people in thinking that all their geese are swans.

DISCUSSION.

Dr. Gilpin.—I fear in this case I will have to endorse Dr. Selwyn; in fact, the advice I have been giving in the last few years has been on his lines as regards alluvial mining in Nova Scotia, but nobody will make any attempt to test it. There is no doubt that there are rich alluvial mines in Nova Scotia, not in large extent of territory but in limited ones which are very rich. I know that in one district a friend of mine makes a very comfortable living out of alluvial mining, but he does it on scientific principles. He takes out the refuse rock and puts it through the mill, but he makes a profit out of it, and I think there are many districts that would pay. As regards the depth of gold mining in Nova Scotia, I can give as an instance a mine which perhaps a great many of the gentlemen here know better than I do, and that is the Wellington mine at Shelburne. That mine was worked down to pretty near six hundred feet, and it proved profitable from the surface down to that depth. I think it was abandoned partly from change of ownership and partly from want of new machinery. It was abandoned I think twelve years ago, but I think it could be worked profitably yet. The past history of mining in Nova Scotia has been confined to high grade veins, and when they worked out it was given up, but the fact remains that it has kept at one stage with slight fluctuation for about thirty years. During the last few years more attention is being paid to the lower grade deposits, and in those deposits the future of gold mining in Nova Scotia is to be found. I think you will have a very interesting and instructive paper before this meeting ("The Treatment of Low Grade Ores") which will bear out a great deal of what I have said. With regard to sinking deep shafts, that has been brought to the attention of the Government at different times, and the Government have, I think, gone so far as to intimate that such shafts could be subsidised, but there is some trouble about getting the proper district, etc.

Mr. W. H. Merritt.—I would ask Dr. Gilpin if he alludes to the free milling conditions or the alteration of the vein at the greater depth.

Dr. Gilpin.—There are cases in Nova Scotia where the proportion of free milling gold seems to decrease and the proportion of gold and concentrates seems to increase; in either case it seems to be pretty uniform. There is no approximately fixed depth below which ores can be worked. The water line, or line of oxydation, in Nova Scotia does not appear to be like it is in other countries; that is to say, there are veins on the surface that are unoxydized and there are veins unoxydized to quite a considerable depth.

Dr. Selwyn.—You find them continue?

Dr. Gilpin.—Yes.

Dr. Coleman.—Do you find in Nova Scotia that there is any free milling gold below the line of oxydation?

Dr. Gilpin.—No.

Dr. Coleman.—I know that in Ontario we have unoxydized veins that sweep away the surface.

Dr. Selwyn.—Of course that sweeping away commenced many years ago and has been continued under favorable conditions ever since. The advantage in Australia is that this oxydised surface has not been removed. The sandstones, slates, etc., are changed into pipe-clay, and it can often be mined with pick and shovel. No costly excavating in hard rock is required. Occasionally the quartz vein stands up quite distinctly in the pipe-clay, and miners have sometimes sunk in it in hopes of getting a "second bottom." Of course they were deceived. There has been no glacial action in Australia to remove the decomposed rocks, as there has been in Canada.

Mr. Miller.—I would like to say a word or two concerning Dr. Selwyn's reference to the gold deposits of Hastings county, Ontario. It seems to me that this district has not received very fair treatment so far; in fact it has received very unfair treatment. Some years ago when these deposits were first opened little was known concerning the treatment of arsenical ores. Difficulties were naturally met with and the owners appeared to have lost courage and worked the mines more with the intention of selling them than of trying to make a profit. They cleared up swamps, built brick houses for the manager and officers, planted maple trees, etc. As late as last December I visited the Deloro mine, and at a depth of one hundred and eighty feet the vein was found to be still defined. A new plant is being put in for the purpose of treatment by the cyanide process by what appears to be an exceedingly strong company. This company appears to have confidence in the district, as they are taking options on thousands of acres of mineral land. I do not know that they are offering any stock or issuing any prospectus, and you see nothing in the newspapers about it; but they are expending over twelve hundred dollars a week in wages although they are not as yet turning out much ore. This expenditure is more or less in buildings. They are also erecting expensive machinery, and more than that they are getting some of the best qualified men that can be got in the country. It should be remembered that these veins have not been continuously worked; they have only been worked by fits and starts and apparently by weak companies. Last year Mr. Rotnwell, who was present here the other evening, had some of this arsenical ore stamped in the Kingston School of Mines. He had some of the pure Mispickel, and he extracted considerably over ninety per cent of the gold contents, treating it in five ton lots, so I think this district should not be condemned off-hand. We know more about treating these refractory ores now than we did years ago. The new process (the Bromo-cyanide) has been tried in London, and there is every hope of its being successful- The Richardson deposit is not a typical one of of the district ; all the others are quite different.

THE PRESIDENT.—With regard to the Wellington mine of which Dr. Gilpin spoke, I think I have heard Mr. Hardman say that it averaged twenty dwts. of free gold at the time. Moreover they had a very small area to work, as upon going down a short distance they found that it dipped into the adjoining property. Then there is the distinction that Dr. Selwyn ought to have made when he said that the operations in Nova Scotia were not creditable to the mines. He probably meant the depth, not the miners.

DR. SELWYN.—I was speaking of the depth.

THE PRESIDENT.—You probably meant the operators.

DR. SELWYN.—One great drawback to Nova Scotia is the large number of mills and the small number of stamps in each. The cost of a staff of engineers and miners is quite as large to run a mill of ten stamps as to run one of fifty stamps, or very nearly so.

DR. GOODWIN.—I should like to make that point a little stronger. It is particularly well seen in the Montague district, where you can see two or three properties, each with its little stamp mill and equipment· If these were all combined into one it would certainly greatly tend towards economy.

THE PRESIDENT.—In Australia they do not do as we do here,—that is, start a broker's office first thing. The miner here or anywhere else is no more responsible for the actions of brokers than the farmer is for the speculations, and wild speculations too, in pork and wheat· Because he raises pork and wheat he is not responsible for the wild and exaggerated stories upon the Chicago Exchange, and for the hundreds of thousands of dollars that are dropped here every month on grain and pork.

DR. SELWYN.—My remark was not meant to blame the miner at all.

The President.—I may say that there are probably a dozen or more mines in operation in Nova Scotia now. I heard it stated in Halifax by a man who ought to know, and I believe it is true, that all those mines are worked to a profit, and some of them make a very handsome profit in a small way. All the speculative ones have been weeded out long ago, and those mines now in operation are being worked by local men and local capital, and all are paying.

Dr. Selwyn.—There is one thing that ought to be insisted on, and that is some regular debtor and creditor account, so that the position of the mine may be perfectly plain to every commercial man in the Dominion Insurance companies, banks and others have to publish a statement of their expenses and their profits yearly, and I do not see why mines should not do the same. They do it in the old country and I do not see why they should not do it here, and then the public would be informed whether they were working at a profit.

Mr. W. H. Merritt.—At this juncture we should hear from Dr. Dawson who has given us a foresight of what may be expected in the great West. Now I am not a broker nor a boomster. I am professionally engaged in mining ; therefore, I do not want to talk a long time, but I will say that I cannot agree with Dr. Selwyn when he says that the vocation of Canadians should be that of a purely pastoral and agricultural character, that we should look forward to being tillers of the ground.

Dr. Selwyn.—I did not say a purely pastoral and agricultural character.

Mr. Merritt.—I am not exaggerating what you stated. Professionally and advisedly I may say that I believe Canada is destined to be one of the great mining countries of the world. Dr. Dawson has given us a foresight of what we may expect in the great North-west. He, of course, must speak as the Director of the Geological Survey, and must naturally speak more conservatively than the ordinary mining engineer would do. I would like also to draw your attention to the fact that the great West in the United States which has developed and produced more than Australia——

Dr. Selwyn.—Pardon me, the records do not say so as regards gold of which I was speaking.

Mr. Merritt.—Produced more in silver and copper than Australia. The metalliferous ores to the south of Canada—of which Canada has an equal area—have produced upwards of $150,000,000 of ore, and there is no reason why Canada, at least within measurable time, perhaps most of us cannot see it, should not be producing her $100,000,000 a year from the continuation of those veins in the United States which time and expenditure have proved to be so rich. These are facts and figures, and I think as Canadians we should hope the best for our country. We can confidently expect to reap some of that success which has been so largely developed to the south of the line. With regard to gold mining in Ontario, we are still in a prospecting and developing condition, but so far the results obtained have been most favorable, and, as has been said, we are justified in entertaining very sanguine expectations as to the product of our Huronian belt in the Western if not in the Eastern part of the province, to which Mr. Miller has alluded. In regard to the Lake of the Woods district, I would like to ask what was their capitalization, what amount did they actually spend in developing. The amount was so insignificant that when the slightest difficulty occurred they had to shut down. This gave the whole country a black eye. That was the chief trouble in the Lake of the Woods district. Take the example of Mr. Caldwell in the Sultana mine. He found it very expensive, but as there was so much money involved he had to raise the money, and he is now reaping a brilliant success as the result of his labors. I remember that there was a reference in Mr. Coste's report to the small amount of work done; it was nearly all arsenical, nearly all refractory ore.

Dr. Selwyn.—I do not think that is in Mr. Coste's report at all.

Mr. Merritt.—My impression is that arnesical and mainly refractory ores were mentioned, but the fact to-day is that the Sultana mine at two or three hundred feet is free milling; the concentrates are small and only run from thirty to forty dollars a ton. Between eighty and ninety percent is free milling. I did not happen to come across any arsenical ore up there, probably because I have not seen as many specimens, but still I have seen a great many and I have not yet run across any arsenical ores, although I have run across base matter. Perhaps Dr. Dawson in his official capacity and speaking very cautiously as the Director of the Geological Survey might tell us something about it.

DR. SELWYN.—Allow me to say one or two words. While I certainly agree with Mr. Merritt that the mining development of this country requires greater enterprise and energy I certainly think it will develop into a very good mining country. I only made the comparison that it would never compare with other countries. I did not say it was bad; I said on the contrary that we should try to encourage in every way the efforts now being made to develop it. I spoke of it in this sense, that the more you work a mine the poorer it gets, while the more you work the animal and vegetable resources the better they get. These are facts that nobody can deny who states the absolute truth, that as the result of development the animal and vegetable products are always going ahead, while the other within given areas, is always diminishing. Then I gave certain figures of the gold products of the United States, as compared with the gold products of Australiasia, showing that Australiasia has actually produced more gold than the United States.

DR. DAWSON.—I did not come prepared to make any statement on the subject on which Mr. Merritt particularly asked me to give an expression of opinion, but I might begin by saying that, with regard to his allusion to Mr. Coste's report, I have a distinct remembrance that he was disappointed in finding so little actual mining in progress at that time. He collected a great many specimens which were assayed, and his report was that there were a number of prospects or incipient mines that would probably pay to work if properly managed. That is about all he could say at that time. As Mr. Merritt knows, even Mr. Caldwell, who is now so successful, had to struggle for a long time with difficulties, and anyone seeing the mine in its initial stages could not have foreseen all that development has since proved. The main point, however, to which Mr. Merritt alludes, that of the general mineral wealth of the Dominion of Canada, cannot be discussed in a few moments. I shall content myself with saying that I have the greatest possible confidence in the mineral wealth of the country as a whole, but at the same time we must draw distinctions, for some parts of the country are very different from others in that respect. For instance take Manitoba and the North-west as a whole; we know very well that we must not expect any very vast mineral wealth there except in coal, petroleum and other coarse minerals and to utilize these we must have an agricultural population not too remote. Turning, however, to British Columbia, where the agricultural land is relatively limited in extent, I have no doubt at all that British Columbia is the greatest hope of the country in regard to mineral wealth. It is precisely analogous to the Southern belt of the country which is producing nine-tenths of all the precious metals of the United States. It is just beginning to be developed now. I have always held that belief and I have had opportunities of traversing and examining the greater part of the province. There is a magnificient mining future before British Columbia. Now about the Lake of the Woods, Rainy Lake and that portion of Ontario generally, we have there a country a good deal different. We have nothing exactly analogous to it anywhere else, and it has got to make its own record. I do not know any country in the world like it. The Huronian formation is more largely developed in Canada than anywhere else, and we have got to ascertain what it contains. So far everything goes to show that it is richly metaliferous, particularly in gold. With regard to the older mining districts of Nova Scotia and the eastern provinces these are already well known. Last year, I think it was, the aggregate products of minerals in the Dominion was over $23,000,000 and it is mounting up every year. In British Columbia it is very likely to double within the next two years. The position of mining in Canada is most hopeful in all respects.

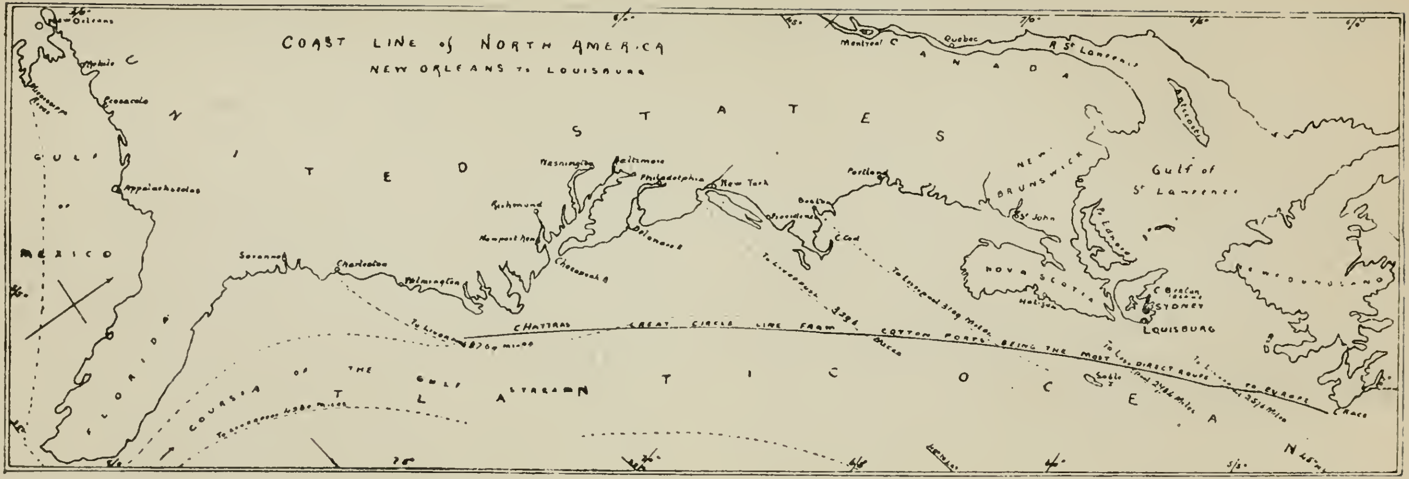
Louisburg: Its Importance as a Coaling Station for Imperial Purposes.

By W. Blakemore, M.E., Glace Bay, C.B.

Among the cities which have flourished and decayed in the past only to come to life again and assume a position of importance, Louisburg bids fair to rank as one of the most noteworthy. It is not a little interesting to open the map of Louisburg showing the fortifications and site in 1746, and to walk over the same ground to-day and find nothing but a few ruins to mark the spot; and standing upon an elevation which is crowned by the monument erected in 1895 to commemorate the capture of Louisburg in 1745, one may gaze over green fields and an undulating hill-slope to the broad Atlantic on the west, and to the landlocked harbour on the east, and see nothing to indicate the strong fortifications, the busy streets, the public buildings and the residences which covered this site and constituted it the objective point of European interest on the North Atlantic coast 150 years ago.

But the wisdom which led the French Admiral to select the Harbour of Louisburg as a safe and accessible haven so long ago, is confirmed by the more prosaic experience of to-day, and it is certain that whatever importance such a shipping port may have had in the the early days of the settlers when the natural resources of the country were not only undeveloped but barely discovered, it must upon all grounds possess an incalculably greater interest now that naval and commercial interests are clamouring for an open port on this coast. Its geographical position makes it the nearest port to Europe being 2,576 miles from Liverpool as compared with 2,734 to Halifax. This brings it at least five to six hours nearer to all points on the continent than any other port, as there is a first-class railway system connecting it via, Truro Junction, with the I.C.R., C.P.R., and through them, with all Canadian lines.

It is close to the sea, well sheltered, with a depth of water enabling the largest vessels afloat to enter at low tide, it lies in lat. 45°, 54′, 34″,



Illustrating Mr. Blakemore's paper, " Louisburg as an Imperial Coaling Station."

long. 59°, 57,′ 15″, W., and has been pronounced by the Admiralty, safe and easy of access. The entrance to the harbour is one-half a mile wide, a lighthouse stands on the north side of the entrance to the harbour on Lighthouse Point, and shows a fixed light, elevated 55 feet, which is visible for 16 miles. The anchorage is excellent, especially in the north-east arm of the harbour, and the ice, which so effectually blocks the shores of the Gulf during the winter months, does not interfere with Louisburg, it being an open port all the year round.

There are several shoals near the entrance to the harbour, and Nag's Head Rock and the Battery shoal after entering, but as will be seen from the attached chart of soundings, these do not interfere with free access, and the depth of water between them is very great, varying from 70 feet to 28 feet, which is the least at low tide. At 1⅝ sea miles from the harbour is an automatic whistle, and from this buoy a fair way N.W. is made between the lighthouse and Battery Island in water which is nowhere less than 65 feet deep until the harbour is entered. From that point a course N.W. gives entrance to the north-east arm and shipping pier.

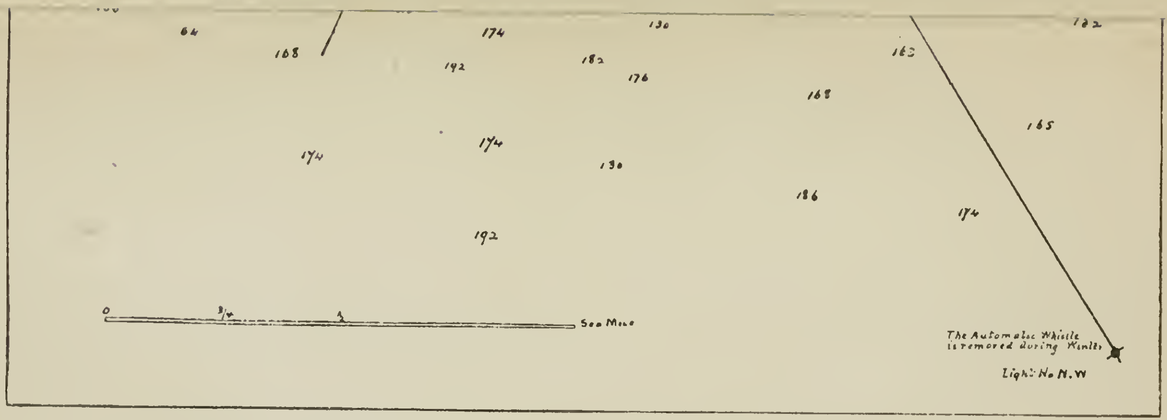
The safety and accessibility at all times of such an important and commodious harbour having been clearly demonstrated, its importance from an Imperial standpoint will easily be recognized when we consider the enormous and available coal deposits which lie around, and the large and increasing squadron which flies the Union Jack on this coast. At the present time this squadron consists of the following vessels: "Crescent" (flag-ship, 7,700 tons), "Talbot" (5,600), "Indefatigable" (3,600), "Intrepid" (3,600), "Pallas" (2,575), "Cordelia" (2,380), "Tartar" (1,770), "Buzzard" (1,140), "Pelican" (1,130), Partridge (755), shortly to be joined by the "Renown." Her Majesty's ships seldom coal at any ports on the Canadian sea-board, except at Halifax or St. Johns, Newfoundland. The bulk of the coal is brought from South Wales and stored at these ports, and the cost varies from $4.00 to $5.00 per ton, there are no mechanical loading contrivances, and the coal is carried on board in the most primitive fashion, in sacks, and wheeled to the bunkers in barrows. Contrast this with the facilities which exist at Louisburg where there is a newly erected pier with the most modern appliances, by means of which a vessel requiring 3,000 tons of coal could be loaded in ten hours, and a total tonnage of 10,000 tons per day is available for shipment at a price which is less than half the minimum cost of Admiralty coal at the other ports mentioned. It is impossible to exaggerate the importance of being able to secure a supply of coal which would satisfy the requirements of any English vessels which might be cruising in these waters without delay, and without incurring the enormous expense as well as risk of first convoying it across the Atlantic. This advantage is sufficiently material at all times, but in the event of war the importance of such a condition would be enormously magnified, and would add greatly to the efficiency of the fleet.

The quality of the coal renders it of the highest value for steaming purposes, it is bituminous and has a high evaporative power. Mr. Robb, C.E., a notable authority, places it at 8.49, and states that this compares favorably with the actual power of British coals as found in the Navy trials at which he assisted ; he gives the following net results :

				Pounds.
Average of	37	samples,	Wales............	9.05
do	17	do	Newcastle........	8.37
do	28	do	Lancashire.......	7.49
do	8	do	Scotland.........	7.70
do		do	Derbyshire........	7.58
do		do	Cape Breton......	8.49

Mr. Robb says, "Experiments have also shown that when burnt in proper furnaces, the bituminous coals have been found to give no smoke, and to have an evaporative power even superior to that of the Welsh steam coals, it is necessary to draw attention in this connection to the resemblance of the Sydney coal to those bituminous coals which gave these results, in containing a low percentage of ash. The director of Naval construction at Brest reported to the French Minister of Marine about 1860 that the steam power of Sydney coal is little inferior to that of Cardiff and equals that of Newcastle coal. With respect to the amount of sulphur, I find that after deducting the harmless sulphur in the sulphate of lime, of the ash there remains but 1.24% or less than the average in 37 Welsh and Lancashire coals, it is 1.42 in both cases, and eight from Scotland it is 1.45, so that this coal will compare favorably in this respect with those from abroad.

It is not necessary, nor is this the place to give detailed analyses of the Cape Breton coals; they are comparatively low in ash and sulphur



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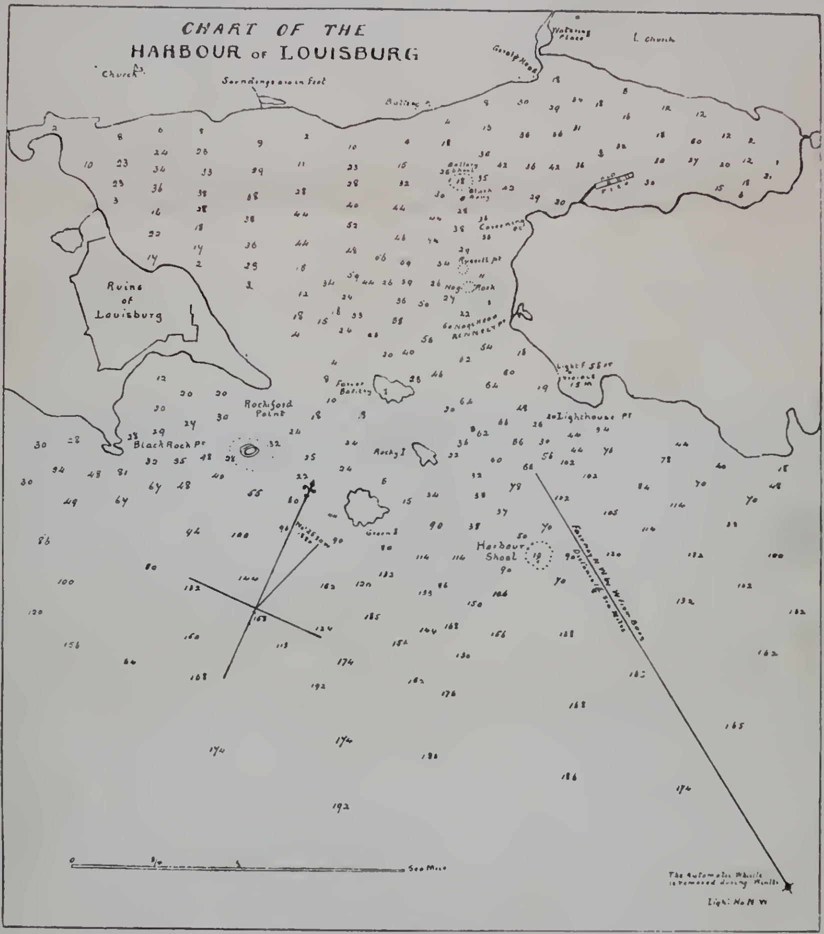

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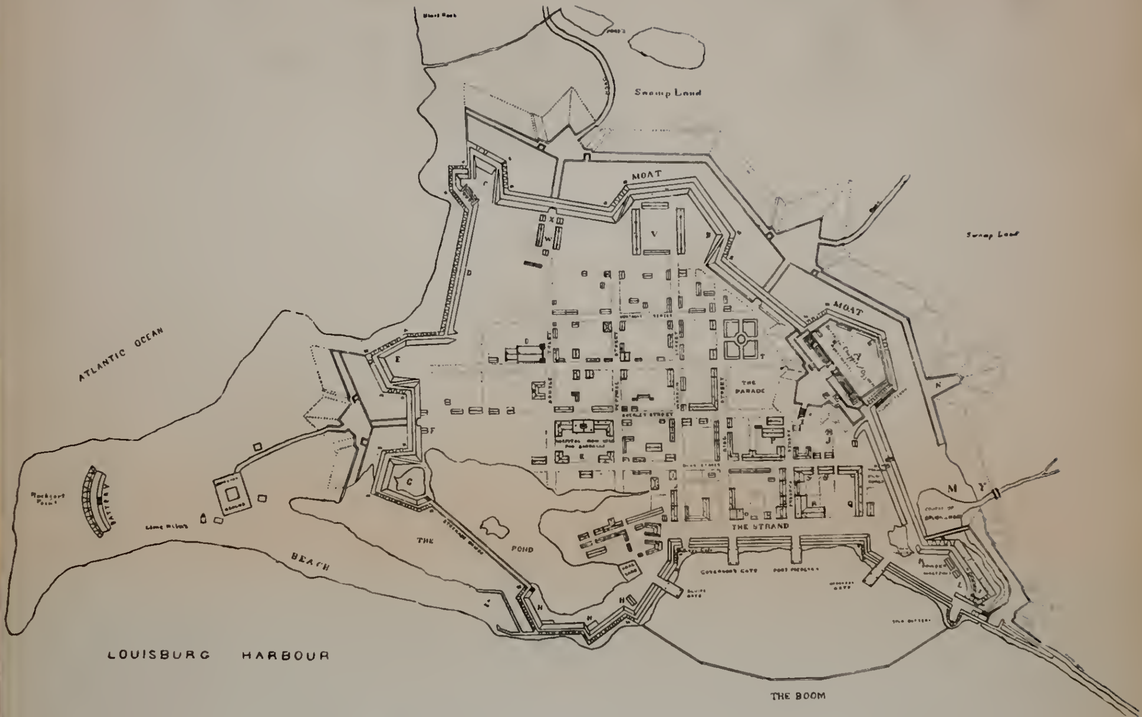

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and high in calorific power and such authorities as Sir Wm. Dawson and Professor How class them among the best steam producing coals known. This expert opinion has been fully vindicated by experience, and the constantly increasing trade done in bunker coal is an additional confirmation. Large liners, which have been accustomed to bunker with Welsh coal have, during the last few years, used Cape Breton coal with satisfactory results, both as to speed and economy.

Sufficient has probably been said to demonstrate the importance of Louisburg as a coaling station, its singular suitability from a geographical and a nautical standpoint, the large tonnage of coal available (1,500,000 tons have already been discovered) and that of a suitable character and quality. It only remains to be noted that this invaluable coal-field, with its plant, machinery erections, railways and shipping piers, stretching 40 miles from Sydney to Louisbourg, is entirely unprotected, and lies at the mercy of any hostile naval power with which we might happen to be in conflict. Several of the most important mines are within a few hundred feet of the shore, and the greatest distance of any does not exceed three miles. In case of war we should depend entirely up our cruisers for protection, and in the absence of these, a few hours bombardment would demolish everything, and not only destroy many millions worth of valuable property, but deprive the British Navy of its only natural coal supply on the Atlantic. In order to conserve this, and prevent the possibility of such a serious deprivation, it is a matter of the highest importance that fortifications should be erected at Sydney and Louisbourg, but especially at the latter. In Sydney we have one of the finest harbours in the world, open to navigation eight months in the year ; in Louisbourg, an all the year round port and harbour, The French spent between $6,000,000 and $7,000,000 to fortify the latter nearly two hundred years ago,—its strategic and economic importance have vastly increased since then and it only remains for the British Government to take the same course now, in order to complete the defence at the Eastern Gate of their vast Dominion, and ensure the safety of their most indespensable supply, at the same time protecting what is at once the most vulnerable and the most valuable point in their defensive armour.

Review of the Pig Iron Trade of 1896.

By Mr. George E. Drummond, Montreal.

The records of the Pig Iron Industry in the leading markets of the world for 1896 afford an interesting and instructive study to the miner, the buisness man, and the political economist.

Tariff enquires specially touching the subject of iron in the United States and Canada, and investigation into the causes of diminishing trade in Great Britain, mark the year, and make it desirable that any review of the iron trade should take into account the political as well as the business phase of the situation.

Protective State Legislation was the foundation upon which and by which the great iron industries of Great Britain, the U. S. and Germany were successfully established. Of these countries, the U. S. and Germany still stand by the principle of protection as being the best method to ensure successful development. Great Britain alone abandoned protection, and then only after she considered her position impregnable. To Canada, in her present somewhat hesitating mood, the relative progress made by the U. S. and Germany, under consistent protection, as against Great Britain, under so-called "Free Trade," should be somewhat of a guide in shaping her own course in the question of the utilization of her natural gifts in iron ores, coal and forest wealth.

On the surface the iron trade returns of 1896 show sunshine in Europe, brought about in part by war office and navy yard contracts, whilst in America the business horizon might be termed "cloudy, with occasional storm signals," and yet even on this continent those interested in iron have very much to be thankful for.

In the U. S. the year closes without significant disaster, with an output of iron close upon that of the previous year, and with returning confidence, born of faith in the strong national fiscal policy foreshadowed by the newly elected president and his party.

In Canada, uncertainty as to tariff matters, the somewhat natural outcome of the recent change in government, has served, in the case of some of the furnaces, to restrict the production of iron during 1896, but on the other hand, as predicted last year, the advent of the Hamilton furnace makes 1896, in point of gross tonnage, one of the best years that Canada has ever seen. The returns received to date from the furnaces at New Glasgow, Londonderry, Radnor Forges and Hamilton, register a total output of 61,839 tons for the calendar year of 1896, being an increase for the furnaces mentioned of 41 per cent. over the tonnage of 1895. This does not include the records of furnace work at Drummondville, Que., of which returns have not yet been received.

Natural conditions in connection with the trade are good, and there has fortunately been a gratifying freedom from bad debts throughout the past year.

Following the usual course, we will review in order of magnitude, the markets with which the Canadian iron producers have to compete, and then deal with the Canadian Pig Iron Industry itself, in some of its various bearings.

UNITED STATES.

As pointed out in this Association's last Annual Review, the year 1896 opened with the largest rate of output in the history of the Republic, promising to show at the close of the year a production of 10,000,000 tons, a pace evidently too good to last, for although it seemed at first almost an impossibility to satisfy the wants of the largest consumers at Pittsburgh and Chicago, yet natural laws of supply and demand, governed by the unusual disturbances of the late presidential election, were at work, and it was soon evident that the output was too great for actual requirements. When the demand for pig iron eased off, it was found that many of the mills had purchased too largely, in eager anticipation of improved business, and the demand for finished products was insufficient to utilize promptly the pig iron contracted for. The furnaces least able to meet the lowest ranges of prices went out of blast, and the trade gradually adjusted itself to circumstances, until at the close of the year prices were inclined to be again on the up grade.

The range of quotations during 1896 will be best appreciated by reference to the figures ruling at the beginning of the year as against those obtainable in midsummer.

On January 1st, No. 2 Southern iron sold at $9 per ton at Birmingham, or equal to $13 per ton delivered at points of consumption in the north. In July it was down to $6.50 per ton at the furnace, or $10 per ton at point of consumption, the southern iron producer always including his freight rate to the point of consumption as part of his cost.

Bessemer pig quoted in January at $16 per ton was less than $10 in July. Northern iron, whilst fluctuating in grey forge quality from $12 in January to $9 in July. and then again upwards to $10, held fairly steady in choice brands of foundry iron, the price for which showed only $1 per ton decline as between the figures quoted at New York, 2nd January, 1896, viz. $13.50, and December 31st, 1896, $12.50. At even the steadier prices obtainable for northern foundry iron, none but the most favorably situated furnaces can hope to make money, and prudence will recommend a curtailment of output until prices again advance.

The ore pool formed towards the close of 1895, managed to maintain their prices throughout 1896, for best grades of Bessemer ore at $4 F. O. B. docks, Cleveland, and in all grades of ore held pretty closely to agreed figures. Within the last few months, however, large ore properties, controlled by strong interests outside the pool, have come into prominence, and it is now a question of considerable doubt whether the ore pool can be held together to control prices during the coming year. The shipments of ore from lake ports during 1896 showed a decrease of about 1,000,000 tons, as against 1895.

Among the interesting and significant features of the year was the demand which came from Great Britain for iron manufactured in America. Commencing in a limited and apparently experimental way in 1895, it increased in volume during the first half of 1896, and assumed considerable proportions in the closing months of the year. One order taken in December for Alabama iron was for 10,000 tons, destined for Liverpool, and for which more remunerative prices were said to be realised than could be secured for the same iron in the American market. The exports of southern iron alone aggregated nearly 100,000 tons during 1896. With steady prices ruling on both sides of the Atlantic, it is thought that this export business will grow from day to day, entirely reversing the order of things which obtained in the trade 20 years ago, when British iron found a place in the regular practice of American foundrymen, and entirely upsetting the "Free Trade" theory that a country in which the industries are highly protected cannot hope for a foreign trade.

In connection with the invasion of England by protected American iron producers, it is a matter of particular interest to note, as per "Cleveland Iron Trade Review" of December 17th, 1896, that "a noteworthy example of the pressing close home to English iron manufacturers of the competition of southern iron is afforded in the contract recently taken for a new subway under the Thames. The Lancashire Foundry Co. that is to do the work will make its castings from American foundry iron, 12,000 tons having been purchased for that purpose."

A presidential election year is always unsettling to the American iron trade, and never in the history of the United States have the issues been so grave as those which were fought out during 1896. The almost revolutionary programme adopted by the Chicago convention in the early summer, and upon which the presidential contest was waged, wellnigh paralyzed the financial energies of the nation, and it is therefore all the more remarkable that the natural strength of the American Iron industry was so great that the year 1896 closes with a record of 8,623,127 tons of pig iron produced, as against 9,446,308 tons in 1895, a decrease of barely 9 per cent., and still leaving the American record of iron production far in advance of that of any of her competitors.

GREAT BRITAIN.

If volume of business, and immediate conditions existing in commercial circles of the British Isles, were the sole gauge, 1896 could readily be set down as a fairly prosperous year.

Returns from the three principal iron centres give the 1896 output,

Scotland	1,180,005 tons	
West Cumberland and Furness District	1,282,260 "	
Cleveland	3,162,308 "	
		5,624,573

as against a total tonnage in 1895, for the same districts, of 5,022,951 tons. An increase in output of 601,622 tons, with an actual decrease in stocks at the close of the year, would indicate a good season's business, but it is a notable fact that the increased trade came from the British Isles itself, and that the export trade showed decreases in the shipments of 1896, as against those of 1895, to France, Russia, Spain, Portugal and Canada.

The prices of Warrants ranged from about 45s in January to 49s. in November, but eased off a little at the close of the year, on account of fear of labour disputes. Maker's brands held at firm figures throughout the year. "Summerlee," for instance, ranged at from 50s. to 52s. 6d. the prices at the close of the year being stiff at the latter figure. Very little Scotch iron came to Canada, the price being so much above that of similar brands of American pig. "Summerlee" brought an average price in currency of $18.75 ex wharf Montreal, or equal to about $20.75 delivered at Western Canadian points. American and Canadian iron was sold at fully $4.00 per ton below these figures, so that the Scotch iron masters were quite unable to compete. The home trade was the salvation of the British iron producers in 1896. Large shipbuilding orders, and the prospect of Government contracts for warships, served to stimulate matters considerably during the year, but while the general tone remained favorable at the close of the year, the constantly increasing shipments of American pig iron and products thereof to the English market, and the ever decreasing export trade in iron from the British market itself, form a combination of circumstances that are not promising.

So far as Britian's trade with Canada is concerned, the fact is very noticeable in the returns for 1896 that the total shipments of Scotch iron to British North America is set down, in Messrs. Jas. Watson & Co's circular of January, 1897, at 2,454 tons whereas 1892 gave a record of 22,913 tons of Scotch iron shipped to Canada. A decline of almost 20,000 tons in tonnage in 1896 as against that of 1892 is very significant.

In the face of the increasing strength of the American competition, it is also anything but reassuring to the British iron masters to know that their home ores are growing scarcer, that the "Black-band" is nearly worked out, and that they require increasing quantities of foreign ore to mix with "Clay-band." The iron mines in Bilbao, upon which the British iron masters have for the past few years depended to a considerable extent, are also getting wrought out, and while they are still good for ten or a dozen of years, the price of the ore is growing higher as the demand increases. British consumers are now turning their attention to the ore from the Almeria and Seville districts, and other new mines are being opened up in the south of Spain, the ore being taken in consumption in greater quantities than has hitherto been the case.

The price of Spanish ore will likely increase rather than decrease, and it will become more and more difficult as time goes on for the British iron masters to compete with their American rivals.

GERMANY.

Total pig iron produced in 1896, 6,360,982 tons, against 5,788,798 tons in 1895.

BELGIUM.

Total production in 1896 (12 months), 990,856 tons, as against a total for 1895 of 828,510 tons.

Comparative figures show that the German output, under Government policy of encouragement, is rapidly increasing from year to year.

CANADA.

As compared with the records of 1895 those of 1896 show a very marked improvement in point of gross tonnage and general operations.

Returns received from the furnaces at New Glasgow, N. S., Londonderry, N. S., Radnor Forges, Que. and Hamilton, Ont., report a combined gross production of 61,839 net tons of pig iron, 12,964 net tons of steel, 1,243 net tons of forgings, and 4,575 net tons of puddled bars, etc.

To produce this quanity the following Canadian materials were used:—

Ore	82,705	net tons,
Coal	114,554	" "
Coke	46,219	" "
Charcoal	557,400	bushels,
Limestone, consumed	34,946	net tons,

although a larger quantity was actually made.

Of foreign material used the Hamilton Blast Furnace Co., L't'd report:—Of American ore, 32,025 net tons, being about 72½ per cent. of their total consumption. Of American coke, 30,217 net tons.

The N. S. Steel Co. consumed of Newfoundland ore 7,269 net tons. Spanish ore, 3,164 net tons, being about 25 per cent. of their total consumption of ore.

The Londonderry Iron Co., L't'd., and the Canada Iron Furnace Co., L't'd., of Radnor Forges, Que., used solely Canadian material.

The details of operations are as follows:—

THE NOVA SCOTIA STEEL CO., L'T'D, NEW GLASGOW AND FERRONA, N.S.

Coke pig iron made	20,470	net tons
Steel made	12,964	" "
Forgings made	1,243	" "

Materials Used.

Coal	113,298	net tons
Coke	28,000	" "
Canadian ore	30,051	" "
Newfoundland ore	7,269	" "
Spanish ore	3,164	" "
Limestone	16,000	" "

Men Employed.

Married	482
Single	193
Boys	30

Wages paid.—$277,500.

Men Employed Mining Coal and other Raw Material.

Married	169
Single	50
Boys	50

Wages paid.—$153,000 for these latter services, or a total wage roll of $430,000.

Total labour of all classes.—965.

This, as in all other cases dealt with, does not include merchants, railwaymen, etc., nor any of those indirectly dependent upon the business.

THE LONDONDERRY IRON CO., L'T'D, LONDONDERRY, N.S.

Coke pig iron made	10,497	net tons
Ore charged	27,053	"
Flux charged	8,882	"
Raw coal	1,256	"
Coke	18,290	"
Total coke raised	29,327	"
Total limestone mined	9,062	"

Furnace Output, 1896—Rolling Mills and Forges.

Three heating furnaces and three train rolls manufactured in 1896.

Iron made (all sorts) 361 tons.

Puddled bar made at works and scrap and other iron made at works—414 tons.

Total fuel consumed—452 net tons.

Iron and Steel Works.

Eight double puddling furnaces in fire and one single puddling furnace in fire.

Production of iron	3,800 net tons
Consumption of pig	4,198 “
Consumption of fettling ore	3,215 “
Consumption of fuel	6,285 “

Furnace campaign of 1896 very brief.

Average number of men employed in all departments, including labor in coal mining, etc.—425.

THE HAMILTON BLAST FURNACE CO., L'T'D, HAMILTON, ONT.

Coke pig iron made		25,270 net tons
Ore used—Canadian	11,876	
American	32,024	
		43,900 net tons
Coke used (all American)		32,176 “
Limestone (all Canadian)		8,469 “

Average number of men employed at forges—120.

CANADA IRON FURNACE CO., L'T'D, RADNOR FORGES, QUE.

Operations in Raw Material Department.

Charcoal produced	630,000 bushels
Ore produced	24,713 net tons
Limestone produced	2,415 “

Charcoal Iron produced in 1896, in a Campaign of Eight Months.

Charcoal pig iron made	5,602 net tons
Charcoal consumed	557,400 bushels
Ore consumed	13,729 net tons
Limestone flux consumed	1,415 “

Average number of men employed—600.

As explained in last report, the labor of this furnace is principally drawn from the farming class, and the field work is therefore of a more or less intermittent character, being performed between seed time and harvest, or at other seasons of the year when the farmer is not engaged in his usual agricultural pursuits.

The auxiliary branches of business in connection with this Company are the Montreal Car Wheel Co., and the Drummond McCall Pipe Foundry Co., L't'd, Lachine, Que. A portion of the output of the furnace is used at the Lachine works, where employment is given to a further staff of 150 men.

PICTOU CHARCOAL IRON COMPANY.

Ore produced—10,784 long tons. From 35 to 40 men employed. Blast furnace idle the whole of 1896.

BRISTOL IRON COMPANY.

Ore produced—1,033 tons Magnetite. This was shipped to the United States by the lessees, Messrs. Ennis & Co., of Philadelphia, Pa.

TORBROOK IRON COMPANY.

Ore produced—8,797 long tons. Mine worked for only four months. 43 persons employed.

As already pointed out, it is difficult in dealing with the history of the Canadian iron trade of 1896, to overlook the investigation which is at present being made by the Federal Government into the merits or otherwise of the encouragement granted to the manufacture of iron in Canada. "Good often comes out of evil," and if the agitation in regard to iron duties, does nothing more than to attract the earnest attention of Canadians to this, the basis of all industries, to the necessity of providing diversified employment for our people, to the fact that this country is especially adapted for the enterprise of iron making, and to the desirability of avoiding national vassalage to our neighbors, in regard to a commodity so important in times of peace or war, as iron, then a long stride shall have been made in the right direction.

The investigations of the Dominion Government Tariff Commission, have naturally brought out arguments for and against the retention of the present system of encouragement to the industry. Human nature showed itself in the arguments. Importers and distributers of foreign iron opposed the native industry, deemed the country not yet prepared for it, although seemingly quite ready for the products of the foreign sources of supply which they happened to represent. Some consumers of iron, arguing that any lowering of the existing duty meant additional profits in their own pockets, went in for that idea, but even they were fair enough and wise enough to suggest, that in event of any lowering of the duties, there should be an adequate increase in the bounties, so that home industry might be preserved, and an American monopoly of the Canadian market prevented.

The bulk of the evidence gathered from the unprejudiced witnesses seems decidedly favorable to the continuance of Government encouragement in some form or another, to the production of pig iron from Canadian ores and fuel.

A very notable illustration of the value of the Charcoal Iron Industry comes from the farmers of the Province of Quebec, hundreds of whom have recently signed a petition to the Dominion Government, asking that the industry be preserved to them.

Firstly.—Because it is one of the very few rural industries that they enjoy, and because, through the resident employes at the works, it provides a ready cash market for farm products.

Secondly.—Because without it, they would be deprived of a cash market for the bog iron ore existing on their own and neighboring lands.

Thirdly.—Because the operations of the furnace provide them with a profitable market for the waste hard woods, which they are compelled to clear from their lands in preparing same for agricultural pursuits.

Finally, the petition points out, that without the labor afforded by the existence of Charcoal iron furnaces, they, as farmers, would be compelled, through climatic conditions, to exist for twelve months of each year upon the profits derivable from five months' work in their ordinary agricultural pursuits.

Such a petition is surely worthy of the best consideration of the Government, for investigation will show that the interests of the farmer in the Charcoal Iron Industry, are relatively even greater than those of the capitalists who have invested their money in the enterprise.

The following are a few points that naturally present themselves in considering the question as to the advisability, or otherwise, of granting encouragement to the manufacture of pig iron from Canadian raw material.

1st. Is Canada naturally fitted for the enterprise of iron making? The work of the Geological Survey has amply demonstrated the existence in Nova Scotia, New Brunswick, Cape Breton, Quebec, Ontario, Manitoba and British Columbia, of almost every class of iron ore known to science, and of mineral fuel in Nova Scotia, Cape Breton and British Columbia.

Wood, hard and soft, suitable for charcoal fuel, is found everywhere throughout the Dominion, and of such quality and quantity that Canada easily ranks in natural resources with Sweden and the United States and with a properly developed industry, stands to secure a share of the world's trade in the highest class of charcoal iron (of which there is an ever increasing demand), at the same time, through this medium, securing to herself a utilization of waste material and an employment of labor of incalculable value.

The moral obligation to utilize such gifts rests upon the Government and people of Canada. The mines and forests must be opened up, either by the Government or the country, or if, as in the case of other iron producing countries, by private capital and enterprise, then, as in the case of the latter under adequate Government encouragement and protection.

2nd. Due consideration must be given to the course pursued under like conditions by Great Britain, Belgium and the United States, the methods so successfully followed in the initial years of development in these countries being presumably good enough for Canada.

History attests that Great Britain gave 73 years efficient protection (from 1787 to 1860) to her iron industry. The trade returns of to-day show that not only has the British iron master been driven out of the Canadian and other foreign markets, but the protected iron makers of the United States and Germany are successfully invading the English market itself, the facts raising a very grave question as to whether Great Britain did not make a serious error when she abandoned the principle of protection.

The United States has already given 34 years of a strong policy of protection, and has just elected Mr. McKinley, and his party to continue that course.

Germany has consistently followed the same road to success. Would it be wise for Canadians to go against all experience and precedent, and follow an untried course, instead of acknowledging the wisdom of the methods adopted by the most successful iron producing countries of the world?

3rd. The necessity of protecting Canadian labor against the lower range of wages paid to European workmen must be considered, and the equal necessity of protecting Canadian capital in the initial stages of the enterprise, against the developed industries of the United States and Great Britain, must be taken into account.

The Association is indebted to Messrs. C. A. Meissner of Londonderry, N.S., and John J. Drummond of Radnor Forges, for the following comparative figures, showing wages paid for labor in Canada as against the rates paid in European markets:

	Blast furnacemen, Laborers.	Coal Mining, Laborers.	Iron Ore. (Mining Laborers.)
Canada......	$1.20 per day	Avg. $1.60 per day	Avg. $1.30
Belgium.......	.58	.83	
Germany.....	.68	.68	.72
Great Britain..	1.06	1.08	
Sweden......	.40	.65	.65

In the case of steel workers, puddlers and others, the same ratio of difference exists as between wages paid in Canada and in the countries mentioned.

Perhaps the keenest competition, in point of labor, that the Canadian producers have to contend with, is that of the negro and convict labor of Alabama and other sections of the southern U.S. Mr. C. A. Meissner, formerly of Alabama, in a recent able paper contributed to the Transactions of the Mining Society of Nova Scotia, says that "the peculiar labor and commissary conditions of the south give the producers of that section an advantage, on labor alone, of probably $3 or more per ton, over the Nova Scotian furnacemen." He says, "the worst feature of the southern labor conditions is the contract prison labor, which is a virtual system of legalized slavery. All State prisoners are auctioned off to the highest bidder, usually a mining company, and then penned up in a camp near the mines and made to work, the company feeding and housing them, besides paying the stipulated price to the State per man. This system naturally allows of very cheap mining, for, while the men are usually treated quite fairly, yet every effort is made to get the most work out of them for the least expenditure."

The absolute necessity of protecting the labor of Canadian workmen against that of Europe and the southern U.S. is apparent, and as for the necessity of protecting Canadian capital in the initial stages of the enterprise of iron making, it must be remembered that the Canadian furnacemen stand, as yet, in a very different position to that occupied by the iron masters of the U.S. and Great Britain, who now enjoy all the benefits of fully developed mines, and of perfected appliances for handling and shipping their ores, as well as all the advantages accruing to a long experience, and the possession of extensive plants, made possible by the large home markets that they enjoy.

The investment in permanent plant for the establishment of smelting works is very large, and the risk to investors greater than in almost any other enterprise, because if unsuccessful it means often a total loss of capital, as blast furnaces and their accessories cannot well be converted to other uses. In addition to this the Canadian furnaceman is at this disadvantage, that the mines of the Dominion not being fully developed, furnaces cannot be established until a sufficient supply of ore and fuel is not only discovered, but secured. Even when the ore is discovered, difficulties are experienced in securing control of it, the rights being often held by speculators at high prices. This difficulty overcome, the Canadian furnace owner has to undertake all the heavy cost and risk of opening up mines, many of which in the end may not prove commercially remunerative, by reason of the quantity and quality of the ore therein.

In these particulars the manufacture of iron from native raw material, differs from the manufacture of any other article now made in this country, because in the latter case the supply of raw material, which Canada is unfitted by nature to produce, can be obtained in the markets of the world as soon as the factories are erected and ready to manufacture.

In the U.S. to-day, the smelting of iron in blast furnaces is a comparatively simple operation, as the blast furnace proprietor purchases his ore and fuel of a specified analysis from the owners of the already developed and active mines. Where charcoal fuel is used he is often able to buy this in the open market from those who manufacture it for the profit they make out of the by-products, such as wood alcohol, acetate of lime, etc. His investment and risk are therefore limited to the mere erection of a blast furnace and its accessories. He is not obliged, as the Canadian often is in charcoal furnace work, to carry a year's stock of raw material ahead, so that wood may be seasoned and initial and climatic conditions met, the American investment being therefore very much less, proportionately to his output, than that of his Canadian competitor.

The American government, appreciating fully these initial difficulties, built up the great mineral wealth of that country by consistently (for now upwards of 34 years) protecting those private investors, who undertook and so well succeeded in the work of opening mines and building up the industry.

4th. It is only just to the Canadian furnacemen of to-day to contrast the average prices which their American competitors were able to secure for their pig iron products between the years 1870 (when the war was over) and 1890—21 years—when the U.S. was busy building up her industry, and years during which the conditions in the U.S. may well be taken as analagous with existing conditions in Canada.

Reference to the second edition of Swank's "Iron in all Ages," page 514, will show that the average prices secured by American manufacturers during the period named, viz. 1870 to 1890 inclusive, for coke iron delivered at Philadelphia, was $25.25 per gross ton and if we even go still further and include the unprofitable and often bankrupt prices of American pig iron ruling from 1891 to the present day, the average price obtained during the 27 years from 1870 to date, by American makers of coke iron, has been at Philadelphia no less than $22.72 per gross ton. Philadelphia is chosen as a base point, as it compares somewhat with the position occupied by such cities as Toonto, London and Montreal, not being an iron producing centre.

Still more marked were the high prices obtained during the years mentioned for charcoal iron, as against the prices ruling in the U. S. to-day. It is most interesting also to note the average figures realized by the Scotch iron masters for their pig iron products during the last 25 years, viz. from 1872 to 1896 inclusive. Statistics prepared by Messrs. Jas Watson & Co., of Glasgow, Scotland, under date 7th January, 1897, show that the average price obtained for Scotch Warrants during the period mentioned was 54s. per ton, equal to $13.20 currency. Add to this the usual average difference between the value of warrants and that of " maker's brands," viz. $1.50, it will be seen that the iron masters of Scotland secured for their " maker's brands " of pig iron a return of no less than $14.70 per gross ton.

It certainly speaks well for the financial strength of the Canadian producers of pig iron, that they have been able to keep their furnaces in blast against the competition of American furnaces during the past five years, when in addition to the initial difficulties and disadvantages already alluded to, they have had to face standards of prices for American iron that were often set by the returns received for bankrupt stocks.

Reference to approximate figures quoted in the *Canadian Mining Iron and Steel Manual*, 1896, *page* 310, show that from 1888 to 1895 inclusive, the Canadian manufacturer of coke pig iron has not received a greater average return than $15.50 per gross ton at the furnace in Nova Scotia, and it is a notable fact that to-day the Nova Scotia furnaces are only getting a return of from $11.50 to $12.00 per gross ton at the furnace, figures that are very considerably lower than the average price secured by the Scotch furnace masters during the past 25 years, competitive with what they are selling at to-day, and ridiculously small as compared with the returns secured in the same initial stages of the enterprise by their American rivals.

It is quite evident that a great part of the brunt of the early development, has fallen on those Canadians who have invested in the enterprise of iron making, and not altogether, as claimed, upon the consumers and tax bearers of the county.

5th. Government encouragement is even more necessary to Canadian producers, than it was to the pioneers of the iron trade in Great Britain and the United States. The developed industry of the United States in 1896 is in point of magnitude, as well as geographically speaking, a far more formidable rival to the Canadian producers of iron than any of the rivals with which the early producers of other countries have had to contend.

6th. Shall Canada safeguard the interests of these capitalists and workmen at present engaged in the manufacture of iron in this country, and who undertook the work in good faith under the policy adopted by the vote of the people in 1887, and which the latter have endorsed down to the present time?

The Canadian people cannot afford to be other than just and honest in dealing with the question, and they must not overlook the fact that whilst cotton, sugar, tobacco and kindred industries, have enjoyed protection for upwards of 17 years, iron, which is naturally much slower of growth, where native materials have to be secured, developed, and utilized, has only had a protection for something less than nine years.

7th. Are our native furnaces producing a quality of iron suitable for the requirements of consumers?

Foundrymen, like doctors, often differ. Those in the trade know how often one foundryman will condemn as unsuitable for his purpose a brand of iron which another man in exactly the same line of business considers an ideal metal. Prejudice and theory enters into the question to a very considerable extent, and for that reason the sweeping assertion made by some consumers of iron that they cannot use

Canadian iron, must not be taken *ipso facto.* There are many iron founders in Canada to-day, who, aside from scrap iron which must necessarily, to some extent, enter into their mixtures, use solely and alone the pig iron product of Canadian furnaces, and secure most excellent castings.

Admitted that for certain work it is desirable to mix say a Western iron with, for instance, the product of Nova Scotia furnaces, in that case why not use, at least in part, the metal produced from Lake Superior ores by such a furnace as the one now located at Hamilton, Ont., rather than the iron produced from exactly the same ores by an American furnace? Wherein lies the difference?

Then if a further diversity of quality is really required, import from abroad for the present, whatever may be actually wanted to make specially fine work. In the meantime let development go steadily on in all the Provinces, the furnaces using ores from the Canadian shores of Lake Superior, rather than from the American shore, from Ontario, Quebec, and Nova Scotian mines until finally Canada, like the United States, shall be independent in the matter of her iron supplies.

Until as late as 1881 American foundrymen occupied the same position with regard to this matter of mixtures as the Canadians occupy to-day. Many of them until then had continued to import and use "Summerlee" and other such brands of Scotch and English iron, firmly believing that they could not get a perfect mixture with the product of their own furnaces. Under consistent protection the latter increased and multiplied. New mines were opened up in different portions of the United States, new ores came into use, American "Scotch" became a known quality of pig iron, prejudice was removed, and the use of foreign metal was discontinued. In due time the same state of affairs will be brought about in Canada.

8th. In event of our native industry being abandoned, upon what source of supply would Canada now, and for the future, have to depend for pig iron and the products thereof?

A reference to Canadian Government statistics, say from 1885 to

1895, or to the same figures given in the *Canadian Mining Iron and Steel Manual for* 1896, *page* 321, *etc.*, will demonstrate the fact that the iron producers of the United States are rapidly driving the iron masters of Great Britain out of the Canadian market. As a matter of fact British iron is now but very rarely used in the iron foundaries of Ontario, the largest consuming market in the Dominion. Take the figures on pig iron.

In 1885 we imported from Great Britain 34,773 net tons, and from the United States 7,389 net tons.

Within ten years it will be found that these figures are completely reversed.

In the Fiscal year 1895-96 we imported from Great Britain 6,525 net tons, and from the United States 32,597 net tons, and the same progress is going steadily on in almost all other manufactures of iron and steel. Where formerly we used British steel boiler plates, structural iron for steel, etc., etc., we now use American. The only possible rivals now and hereafter to the American producers of iron and steel will be our own native furnaces and mills, and it is for the people of Canada to consider which is best, in the general interests of our country, to sustain and encourage.

9th. What has been the effect of the iron duties on the shipping interests of Montreal and other ports of the Dominion, and what will be the effect on the railroad interests if the Canadian iron industry is injuriously affected by a change in the policy of protection and encouragement?

British iron to-day competes with American under exactly the same tariff. As already shown, the British iron masters have almost abandoned the market, acknowledging that they cannot compete with their American rivals. Quotations on British pig iron for delivery in Ontario towns run fully $2.00 to $3.00 per ton over those of equal quality of American make. Competition is impossible on these terms. If pig iron was admitted free into Canada the relative position as between the English and American iron producers would be unchanged, and not a single ton additional freight could be secured for

Western Canadian points by the vessels plying between the British ports and Montreal, or other Canadian points. A glance at Government statistics will prove to the vessel owners that they can have no hope to increase the tonnage of pig iron from British or European ports by any decrease in Customs duties.

It has been claimed that the iron duties injuriously affect the interests of the vessel owners by stopping the importation of bar iron. A further reference to official statistics will evidence the fact that so far as tonnage is concerned, scrap iron, the present raw material of the leading Canadian mills replaced for a considerable time the loss of bars, the vessels from London and such ports simply taking the tonnage which formerly came in the shape of bars from Liverpool and Glasgow. The Americans to-day are capturing even the scrap iron trade, the vessel owners losing, but not through the operations of the iron duties.

Any legislation tending to injure the native iron industry of this country will be a direct blow at railroad interests. This can be readily understood when the fact is considered that Nova Scotia, Quebec, and Ontario furnaces have to depend very largely upon the railroads for not only carrying their finished goods to the market, but first of all to bring the raw material to the furnace. It is only necessary to mention one or two cases in point as in illustration of what the manufacture of iron means to railroad enterprise.

For instance the business of the Londonderry Iron Co., and the Nova Scotia Steel Co., L'td., combined, means a revenue of $200,000 per annum to the Intercolonial Railway and connecting lines, a very important factor to the Government.

In the case of the charcoal iron furnace at Radnor Forges the revenue derivable therefrom by the railways amount to upwards of $35,000 per annum, and with the expected increase of operations at that point, which will assuredly come if a consistent policy of Government encouragement is maintained, these revenues will constantly increase.

Those interested in railroads in the United States and Great Britain appreciate most fully the great importance of the iron industry as a provider of freights, and it may be readily assumed that our own Canadian railroad managers also understand this thoroughly.

10th. Is pig iron a raw material or a finished article ?

Presumably it will be admitted that the best gauge as to whether an article, which nature happens to have fitted the country to produce, is to be considered as a raw material or a finished article, is the amount of native labor employed to bring it to a merchantable stage. If taken on this basis the manufacture of pig iron from Canadian raw materials, by Canadian labor, must be considered a far more valuable enterprise to the country than the mere manipulation of the metal in the iron foundries of the country. It is quite safe to estimate that $2.00 is spent in labor in producing coke pig iron from the ore, where $1.00 is spent in transforming it into castings. In arriving at the relative value it must not be forgotten that the fuel used in our western foundaries is invariably the product of American mines and of American labor. Where $10.00 is spent in labor (the raw material all representing labor) in producing coke iron in Nova Scotia, only $5.00 is spent in tne labor of resmelting this pig iron into castings in the foundries of Ontario and Quebec. Where charcoal is used as a fuel in smelting native ore, as in the case of Quebec furnaces, the labor value to the country of such pig iron is from three to four times as great as that of smelting it into castings in the ordinary foundry. Pig iron then may well be considered a finished article, and should be protected and encouraged as such

Consumers of iron have sometimes claimed that if they had their so-called "raw materials" (pig iron, etc.,) free, that they would be willing to have the protective duties on their own products lowered. The manufacturer of pig iron cannot occupy a similar position because his industry, being an initial one, he has no one to fall back upon, except indeed his workmen, a position which would certainly be detrimental to every Canadian interest.

11. Shall we have a protective duty or a system of bounties ?

Three leading interests are involved—(1) The producers, (2) the consumers, (3) revenue.

Assuming that the object of all is to develop the manufacture of iron from native ores, and native ores only, it would be better to increase the bounty and decrease the duties The experience of all who have taken part in the enterprise of iron-making in Canada, is that whilst development has gone steadily forward, the business has not, in the nature of things, up to the present, proved a paying investment. Most of those now interested in a direct financial sense, might have done better to have simply invested their money in bank stocks, and allowed their workmen to seek employment in the United States or elsewhere. The facts in connection with the industry prove that in the present stages of development a less encouragement (protection and bounty combined) than is now afforded, would mean that progress would be seriously retarded. Supposing then that the present total amount of encouragement is allowed, make the duty $3.00 per net ton and the bounty $3.00 per net ton, and only pay the bonus when Canadian iron ores are used. This change would have the effect of encouraging producers of iron to develop the mines of the country, so that they might earn the bonus. The consumers would be able to purchase their material $1.00 per ton less than at present, and as Canadian furnacemen have not for some time past taken advantage of the full amount of the protective duty (selling, as they do, their product to western consumers at almost 10 per cent. below the price of American iron, delivered duty paid) the Canadian consumers would be able to purchase their metal reasonably close to the prices paid by their competitors in the Northern American States. The revenue of the country would have the benefit of $3.00 per ton on such American iron as might be imported into the country for the present, all the interests being thus, as much as possible, conserved.

12th. Specific *vs.* ad valorem duty.

The experience in all iron producing countries has been that a specific duty is the only safe form of duty on pig iron. In the first place it is impossible to determine the value of pig iron in its natural form. Second, the freight from distant iron producing points, such as Great Britain and the Southern States, forms a very large part of the value of the iron itself, the only safe basis of valuation therefore is the, point of consumption, and not at the works where the iron is produced. In adopting a specific duty the argument which obtains with regard to many other articles of consumption, viz.: that the poor man pays as much on his necessity as the rich man on his luxury, does not carry weight with regard to pig iron, inasmuch, for instance, as the iron used in the manufacture of the rich man's furnace may, by reason of the greater weight of the casting, be of a poorer quality than that used in the poor man's stove, where the plate being very thin the metal used must necessarily be of strong and good quality. Further, the highest class of iron, and the most costly, viz.: charcoal iron, is most generally used in the manufacture of articles upon which the safety of human life depends. For instance, the manufacture of railway car wheels, electric trolley wheels, structural work for buildings bridges, etc., etc.

Legislation, affording protection and encouragement, through bounties, should be left entirely in the hands of the Dominion Government.

The British North American Act of Confederation (of 1867) vested in the Dominion Government the regulation of Trade and Commerce (30 and 31 Vic. Cap. 3, clause 91.) Speaking specially for the Province of Quebec, it was assuredly upon this distinct understanding that we became an integral part of the Confederation.

In November, 1894 the Government of Ontario, of which Sir Oliver Mowat was then premier, placed upon the statute books of that province an admirable, but unfortunately, sectional Act, entitled "An Act relating to mines and mining lands," by which Ontario appropriated the sum of $125,000 to aid miners and producers of iron ores in developing the ore deposits of that province. Clause 12 of the said Act anthorized the treasurer of the province to pay out to miners, or producers of ore, upon all ores which shall be raised or mined and smelted in that province, for a period of five years from 1st July, 1894, the equivalent of $1.00 per ton on the pig metal products of such ore, this to a maximum of $25,000 per annum.

The Act in question was only passed after a most careful examination into the causes that had, up to that time, served to retard the development of the iron industry in Ontario. The local legislature, in its wisdom, decided that it was of the utmost importance that the industry should be fostered, and secondly that the encouragement afforded by the Federal government to the manufacturer of iron from native ores, and which amounted to a combined duty and bonus of $6 per ton, was insufficient to bring about a successful establishment of the industry. They fully recognized the heavy initial expenses which would fall upon those undertaking the opening of the mines and the general development of the enterprise, and therefore determined to do what the Federal government should have done, viz. to increase the encouragement. The Act of November, 1894, was the result. The Act in question, in other respects admittedly wise, unfortunately violates if not indeed the letter of the law as laid down in the British North American Act, certainly the spirit of that law, for in affording an undue advantage to Ontario producers of iron, it in affect legislates directly against freedom of business as between the provinces comprising the Dominion of Canada, several of which provinces, for financial and other considerations, cannot attempt at present to follow the lead of Ontario in affording similar additional encouragement to the producers of iron within their own boundaries. The considerations which led the government of Ontario in November, 1894, to offer additional encouragement for the utilization of its ores, and the manufacture of iron therefrom, should have at least sufficient weight with the Dominion Government to prevent any possible reduction in the present Federal encouragement, and at the same time, in simple justice to the other provinces of the Dominion and for the safety of inter-Provincial trade and commerce, steps should be taken to rescind the Ontario Act in question, and preserve to the Dominion Government the sole control of the policy of encouragement.

MARKET.

Canada ranks, per capita, as a consumer of iron second only to Great Britain and the U. S., and as the country progresses her demand for iron and steel will increase not only in tonnage, but probably also in ratio.

It is estimated that since Confederation, we have imported iron and steel, and the manufactures thereof, to the value of nearly $400,000,000. With the natural advantages which the Dominion possesses for the manufacture of iron, is it reasonable that we should go on importing our requirements, and annually draining our country of enormus sums of money?

In an able article recently prepared by Mr. C. A. Meissner, manager of the Londonderry Iron Co., one avenue of development is pointed out in the opportune statement that "there is only one country under the sun with 15,000 miles of railway that does not manufacture a single steel rail, and that country is Canada."

Aside from pig iron and steel rails there is annually a very large consumption of bar iron and steel, hoop and band iron, iron and steel boiler plates and sheets, chain cables, slabs, blooms, bridges and structural iron and steel, iron and steel for ships, steel ingots, bars, billets and other forms of iron and steel, and the productions thereof, too numerous to mention, the greater portion of which is now imported into the country.

If the materials we are obliged to import came, as formerly, from Great Britain, Canadians might accept the situation. Unfortunately there is little hope of this. The mines of the mother country are in many districts well nigh worked out, the British iron masters have to increasingly depend upon a foreign ore supply, the cost of production being so much increased thereby that pig iron and finished material of American and German manufacture will not only compete successfully for a share of home trade, but may in time actually have to be depended upon to supply absolute requirements, unless, indeed, Canada and the other colonies come to the rescue, by building up industries that will make the Empire perfectly independent with regard to an article so absolutely necessary to the life of the nation as iron admittedly is. For the present Canada possesses an ample home market for the output of her coke furnaces, and not only a home demand, but the probability of a large foreign trade for her charcoal iron. Surely such an industry is worthy of a broad and comprehensive policy of encouragement from her government and people; such a policy as will give confidence to both capital and labor, so that the work of development may go forward without hindrance.

DISCUSSION.

MR. GRAHAM FRASER (Nova Scotia Steel Co.)—I am not the talking director of our company, but I may say that I have been very much interested in Mr. Drummond's paper. I agree with him in many things; in fact I think that I can agree with nearly everything that he said; but there is one point that I did not quite catch, and I would ask Mr. Drummond with respect to it. I refer to the bounty paid on pig iron made from native ores. He has told us that a large amount of labor is expended in getting the fuel and also the flux, and I would ask whether that should not be considered when the bounty is paid on iron as well as on ores?

MR. DRUMMOND.—I quite agree with you.

MR. FRASER.—I think myself that it should be so considered.

MR. DRUMMOND.—Under existing conditions, decidedly.

MR. FRASER.—Then there is the question of freights to Canada from the old country. Of course that has been pretty well threshed out, and it is quite evident that the steamers would receive no more freight if we had free trade in iron. There are also a great many other points in connection with the paper, but I may say that we have Mr. Stairs and Mr. Graham of our company with us, who might give some information. If they say anything that is wrong I will put them right.

MR. JOHN F. STAIRS.—I feel with all the other gentlemen present that we owe a great deal to Mr. Drummond for his able paper, but I do not feel just now in a position to discuss it. I would, however, like to say something later in the evening if there are any questions asked. I feel so deeply that it is a paper that should be discussed, and knowing a little about the manufacture of iron in Nova Scotia, I would be willing to answer any questions that should be asked. I think that the gentlemen present should catechise you a little, Mr. Drummond, and in that way we could bring out the facts more clearly, and I would suggest that those present would now ask questions.

Dr. Gilpin, Inspector of Mines for Nova Scotia, having been called upon, said: I think, Mr. President, it would be out of place for me to enter into any discussion after these gentlemen who are so cognizant of the business have spoken. I could not follow all that Mr. Drummond has stated as regards the competition of American pig iron in England, but I have always understood that it was rather of a temporary character. I think, however, that the British producer has all he can do to supply the home market and also to supply the demand from Germany. I understand that the southern pig iron is peculiarly adapted to England, and therefore was received with some favor.

Mr. Drummond.—In reply to Dr. Gilpin I may say that England has not got anything like the trade that her furnaces can supply. Those who have been in the trade as I have been for some years (I may say that I represent a good many English furnaces as well as a good many Scotch furnaces) can understand this. A large number of furnaces have been idle, and while last year was a very fair year, still England and her workmen are feeling very seriously the depression caused by the trade that is being taken away from them, the depression caused by the loss of the Canadian and other foreign trade captured by the American and German producers, and perhaps worse still the loss of their own home trade by the American and German iron and products thereof. The English capitalists feel this matter very keenly; they feel that while their market is open to Americans, the American manufacturer has his own market reserved to him under protection, and can then compete with the English capitalist in his own market. I can give you the evidence of Americans who ought to know; I can give you the evidence of one who was here within the past week, and who is now doing a large business in London. He says that they are there to stay, and what is more, my English and Scotch friends acknowledge that they are there to stay.

Mr. Harvey Graham.—I can, with other gentlemen who have spoken, congratulate you, Mr. President, very highly, on the admirable paper to which we have just listened. I have not yet heard any paper which has discussed this question so exhaustively as the one we have heard to-night. The amount of research and care that must have been spent upon it is most creditable to Mr. Drummond. Naturally we who are interested in the industry think that iron is the greatest industry in the country. Free trader as I am, I think this is the industry above all others which requires the fostering care of the Liberal Government. This is the industry above all others that helps to build up the country, that helps to develop its strength and resources as much, perhaps more so, than any other industry that is in existence. I am sorry that the evening is so late, for I think a whole night could be spent profitably and properly in discussing this subject. There are some points in the paper which, while not controverting them, I would like to discuss a little more fully, but I do not think it advisable at this late hour to discuss it any further.

Mr. Stairs.—In connection with this discussion I may say that I will not be able to be present at the other meetings, and as the matter is so very important I would just ask the attention of the members present for two or three minutes. I want to say one word upon the general question of the manufacture of iron, and in justification of the policy which has been pursued, and it is that the iron makers of Nova Scotia—that is, those gentlemen managing the company with which I have the honor to be connected—have had in anticipation that if in the future they were able to reduce the cost of their product they would be quite ready and willing to do so. It is quite true that it has been cheaper in the United States than in Nova Scotia, but in Alabama and in Virginia it has been brought to my notice very strongly in connection with the figures discussed before the tariff commission that it is altogether a question of wages. If we in Nova Scotia were able to compete in wages with those in Alabama we could make iron as cheap as they do. We would of course always be able to get the price of our iron very much reduced by improved processes of manufacture. In compiling some figures the other day, I noticed that in the last seven years the selling price of the steel of the Nova Scotia company was reduced to $14 per ton, and in time we expect to get it down still further. This shows that the iron and steel industry in Nova Scotia has been a progressive one. It has increased its capacity in the last seven years. As you know, sir, and as every man present in this room knows, if you want to keep up to the times you must put in new and improved plant and machinery. One of the things that the iron makers have to contend with in the Ontario market is the long distance, and the heavy freights to be paid by rail, and in this connection I may say that the iron people of Nova Scotia look with favor upon the deepening of the St. Lawrence canals. They think that by the deepening of the St. Lawrence canals the question for them is very largely to be solved, as it would put them in a very much better position to compete with the Americans than they are at present. With reference to the remarks of my friend, Dr. Gilpin, about the competition of Southern iron in England I may say that I, with him, thought that it was only of a temporary character and would only last a short time, but later on I came to the conclusion that it had got into England to stay; and I am afraid that northern iron and steel billets will get in to stay too. The question was brought out at the Tariff Commission when we met the other day, and it showed the price of steel billets in the United States and in England, and either the Hon. Mr. Fielding or Sir Richard Cartwright asked why it was that with such a great difference in the price in the United States and in England these steel billets did not go into England. It was stated then that the price in the United States had not been down to this low point for very long, but if it continued the English iron masters would have to look to their laurels or their United States brethren would be competing with them successfully, and would take away from them a very large proportion of their trade. As the hour is late, and I know that the gentlemen want to get away, I will say no more at present.

MR. HARVEY GRAHAM.—Mr. President, I can give you some evidence as to the cost of labor in Alabama. One gentleman writes to me that his company could get 300 men, that is common laborers, at seventy cents per day on two days' notice. Another letter from the same gentleman a day or two later, says that unskilled labor is ninety cents per day; the other cost of labor is sixty-five cents per ton of pig iron. They have two furnaces. In addition to that there are the truck stores from which their workmen are paid, and the profits of these truck stores amount to a profit on the whole industry. When a man is working for seventy cents a day and takes his pay in goods the net cost of his labor to the company is from thirty-five to forty cents a day, or fifty cents a day at the most, as against $1.25 a day in this country.

DR. J. B. PORTER.—You could get a fair grade of workmen in Alabama for seventy-five cents a day in any quantity—fairly intelligent negro labor—and the negro of Alabama and of the south is now trained to be a fairly good furnaceman. I know that one of the best furnace foremmen I ever knew was a negro, and he had practical charge of the furnace, of course under the superintendent. One of the best puddlers I ever knew was a negro; he was a very good man. When I am speaking of a puddler or a foreman I am not speaking of any ninety or seventy-five-cent men, but you could get a very good man for furnace work or handling ore for from sixty-five to ninety cents a day, and then the goods' store in some cases enables a still further reduction on that. However, there is conssderable legislation against that, and I do not think that it will last very long. There are only a few places where it exists now, and I trust that very soon we will see the last of them.

THE PRESIDENT.—We have to thank the members for giving so much information, particularly in regard to labor in the south. It shows what the iron producers have got to contend against, and I hope that the government will be as unanimous as this meeting appears to be in helping to build up the great national industry of this Dominion.

The Protection of the Forest in the Mineral Belt.

By J. BAWDEN, Kingston.*

The frequent references to forest fires in the reports of our Geological Explorers, and the known destruction of extensive areas of timber land through the carelessness of mining prospectors, point to the importance of safe-guards for the preservation of the forest from wasteful and wide-spread destruction, and show the necessity that such should engage the attention of the Government at this time. It is important that every prospector should not have only the protection of a Miner's License, but it is also important that the right to traverse the public lands for purposes of private gain, shall carry with it responsiblity for the use of fuel for the camp fire in a careful manner. The mining prospector should be required on taking out a license to enter into a bond to observe rules respecting the use of fire for cooking purposes. Rangers should be placed at different parts of the mineral district with authority to arrest prospectors and travellers not in possession of miner's licenses. The value of forest fuel to the working miner is of immense importance. The mining community will hail with satisfaction any efforts on the part of the Government to protect the natural fuel supply from the destruction which invariably follows the careless use of camp-fires in the dry season.

It is scarcely necessary to refer to the great forest fires in the mining regions of Minnesota, which ended in the destruction of mining camps and lumbering towns, attended with loss of life, as a warning that similar results may be looked for in the Rainy River District. The companies which are about to erect valuable mills will be well advised to urge upon the Government the importance of strict legislation for the preservation of the forest.

In British Columbia it is within reasonable probability that the immense forest wealth of that great Province will be swept away by forest fires following as a necessary consequence the careless work of explorers. Whether the mineral riches of individuals may be advantageously purchased at the expense of the destruction of forest wealth is a question about which publicists and politicians will differ. There is no reason why the advantages of mineral development should be purchased at such enormous cost, as the history of the destruction of immense forest wealth in California and elsewhere would warrant us to expect in British Columbia. The destruction of the light timber and soil of a mineral range may perhaps expose mineral wealth which otherwise would lie unknown for ages. There is a certain degree of temptation before the unwatched prospector who contemplates the cheaply won gain which a forest fire may reveal. The danger which follows from converting a good servant into a bad master will hardly warn a reckless prospector. It is to be hoped, however, that the public and the Crown Lands Department will not allow him to try conclusions in such reckless fashion that the holocaust of an entire forest region, with many crisply burned human victims, may be among the sad consequences.

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*Paper read before the Ontario Mining Institute, April meeting, 1897.

The Western Ontario Gold Fields and their Genesis.

By Mr. F. Hille, M. E., Port Arthur, Ont.

When I first became acquainted with this country, now nearly eight years ago, silver mining and prospecting were very actively pursued, and locations were almost as thick in the market as the mosquitos which guard and viciously defend the treasures of these lands. The great richness and the success of a Silver Islet Mine, which was not only well known abroad, but was also believed would be repeated in other mines, as the bonanzas of a Badger, Beaver and Silver Mountain Mines were loudly talked about. This was why I was sent here to examine a greater number of locations which were held at low and high figures, and at still higher pretentions in the market. I came, I saw, and—I was conquered, then after I had finished my work and had seen quite a stretch of land and recognized the possibilities of its mineral resources, I concluded to settle down here, to stay with them and learn more about them.

During my numerous travels through the country I came repeatedly in contact with mineral deposits and especially in the form of quartz veins, which were of quite a different character from those veins in the Cambrian silver bearing rocks, with their calcite filling, and also in quite a different formation from the argillites presented in the latter. The samples which I took with me and tested contained more or less gold, silver, copper, lead, zinc and iron, but always in such an amount that it encouraged me to commence teaching our prospectors, and inhabitants of Port Arthur, and urged them through the papers as well as verbally, to search for other metals than silver, but especially for the more precious—gold.

It was indeed a hard uphill work to lecture at that time against those silverites which were almost as numerous there as the followers of the late-Mr. Bryan. High and low "compliments" were tendered me

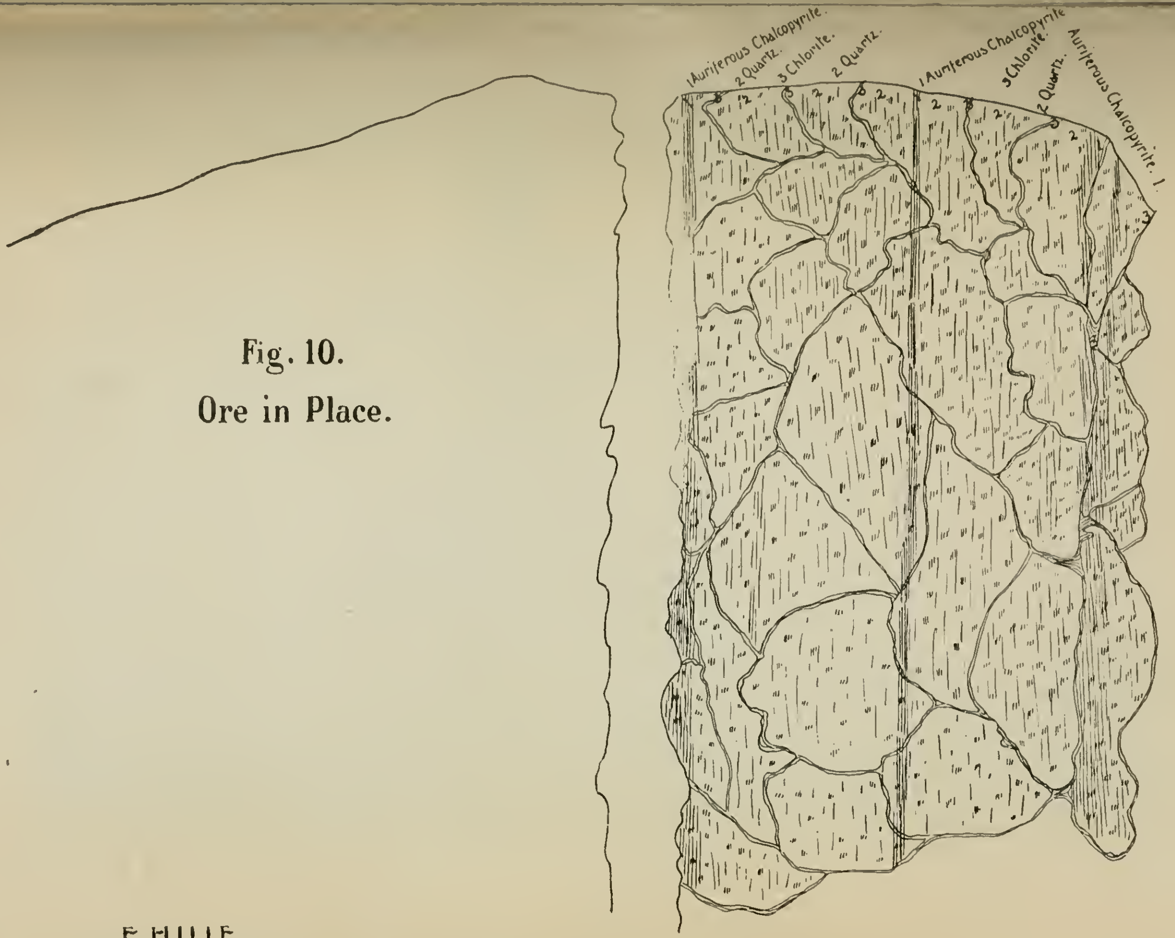
1 Auriferous Chalcopyrite.
2 Quartz.
3 Chlorite.
2 Quartz.
1 Auriferous Chalcopyrite
3 Chlorite.
2 Quartz.
Auriferous Chalcopyrite. 1.
2
3

Fig. 10.
Ore in Place.

F HILLE,
MINING ENGINEER
—AND—
ANALYTICAL CHEMIST.

so frequently, and in such varying phrases, as if they had been prompted by Illinois' versatile Governor. But a good cause will always win at the end; the prospectors who had followed my advice were handsomely rewarded; they found iron, copper and gold, the latter especially widely distributed through the country. As far back as five years ago I was so sure of the frequent occurrence of gold that I could answer with confidence to an article in one of our Mining Journals in which the writer asked, "How we should make up for the deficiency of gold without going to the interior of Africa?" I tried to console him that it would not be necessary to rove so far from his penates, because there were alone fifteen thousand square miles of gold bearing land at the very doors of the States of Minnesota and Dakota, and if any country would make up for the deficiency of gold it would be Canada. Now, gentlemen, what I said in 1892 is still more true in 1897, because we have found in our two western districts on so many places, and distributed over so wide an area, very good and in many cases phenominal gold deposits.

I had first the intention of giving you, gentlemen, a detailed description of all the different localities where gold is found in our two western districts, but a second thought led me to conclude differently, because our able and hustling Director of Mines is two much on the "qui vive" to leave me anything to tell you in regard to new finds and their localities. Also those naughty inquisitive newspaper men get at our most sacred secrets and reveal them in ever renewed and enlarged editions, so that I am obliged to treat upon a subject which is for most people too dry to be spoken of among the daily news of our papers. I mean the origin—the genesis of our gold deposits. Now I shall not attempt to speak here in detail of all of them; instead of doing so I shall select two which I consider the most interesting from a geological and from the standpoint of the miner in our western districts, that is, the Bad Vemilion Lake and the Saw Bill Lake deposits. Perhaps I should have included here also the important Lake of the Woods camp, but I will spare this for another paper.

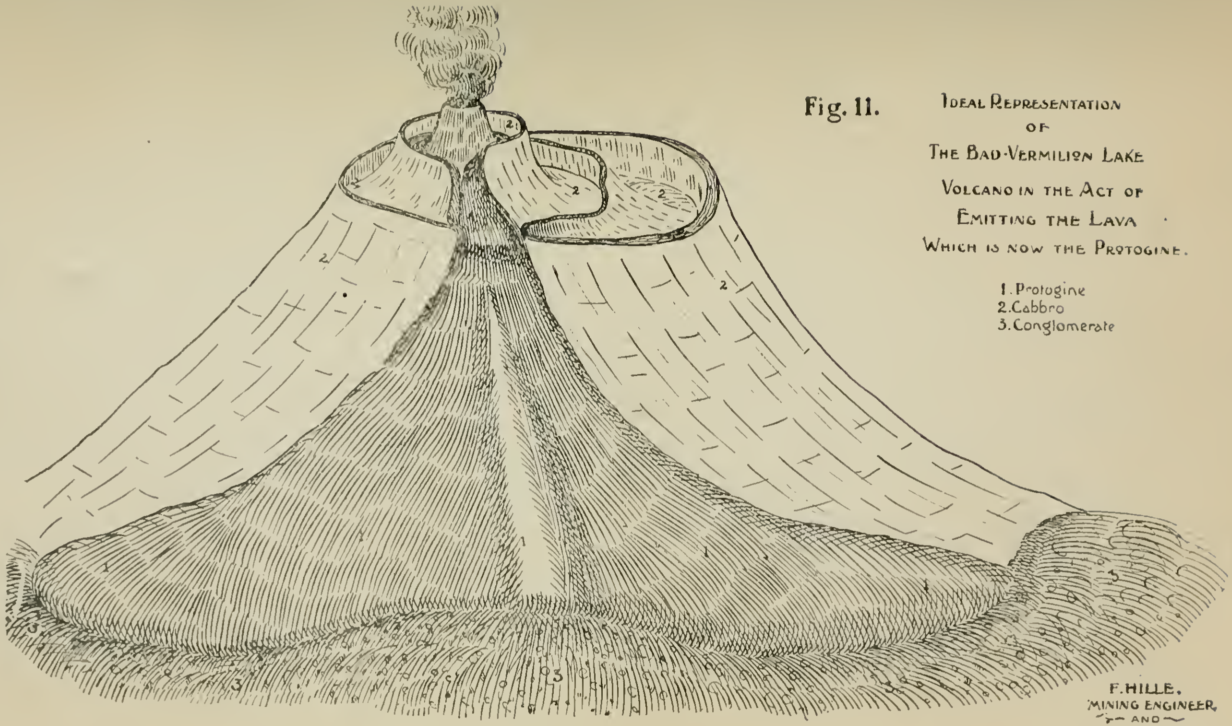

Fig. 11. IDEAL REPRESENTATION
OF
THE BAD-VERMILION LAKE
VOLCANO IN THE ACT OF
EMITTING THE LAVA
WHICH IS NOW THE PROTOGINE.

1. Protogine
2. Cabbro
3. Conglomerate

F. HILLE.
MINING ENGINEER,
AND
ANALYTICAL CHEMIST
PORT ARTHUR, ONT.

Most of you, gentlemen, will be aware that all of our gold veins are found in the Archaean and principally in the upper part, in the Huronian and there again in the younger series, in the metamorphic rocks, named by Dr. Lawson, the " Keewatin " ; but I might add the most important in perhaps "post Keewatin" eruptive rocks. Now we may justly ask, why do we find so many veins, and especially such containing gold just in rocks of that period ? The answer to this is not so difficult; if we make a resume of our observations and studies in the field. In the first place before a vein can be formed a space has to exist in which vein matter may be deposited, that is, an opening, a split or rent in a rock must first be produced, in which a current of mineral water can flow and deposit its contents therein. Now after the Coutchiching—the lower Huronian, and the Keewatin rocks were laid down, the floor of these rocks, which was the magma of the present gneisses, solidified, contracted and tilted thereby the overlaying older rocks which became fissured, torn assunder and contorted in all shapes, especilly so opened the layers of the slates at the anticlinals We can produce this dynamic action in the laboratory, by taking a number of thinly rolled out sheets of half plastic clay, the lower should be a little thicker and more plastic ; put them on top of each other on a table, then take both hands, press slowly and move them inwards. We observe how synclinals and anticlinals are formed and how the axis of the latter breaks and opens, that is the layers will separate at the top of the anticlinals, and the fissures are produced. In this manner we see also how the openings for bedded veins are formed. Now these fissures served for different purposes, not only as receptacles for the contents of mineral waters, but also for the magma of the gneisses which became eruptive by its contraction and was injected therein, or became the vents for later intrusive rocks. But it seems as if that same period had been not very favourable for the deposition of economic minerals in paying quantities ; this was left to a later which we might call "post Keewatin," when the granites, diorites and diabases broke through the fissures of the gneisses and their overlaying rocks. These eruptions must have extended to the post Cambrain age, as this is plainly visible among the upper copper

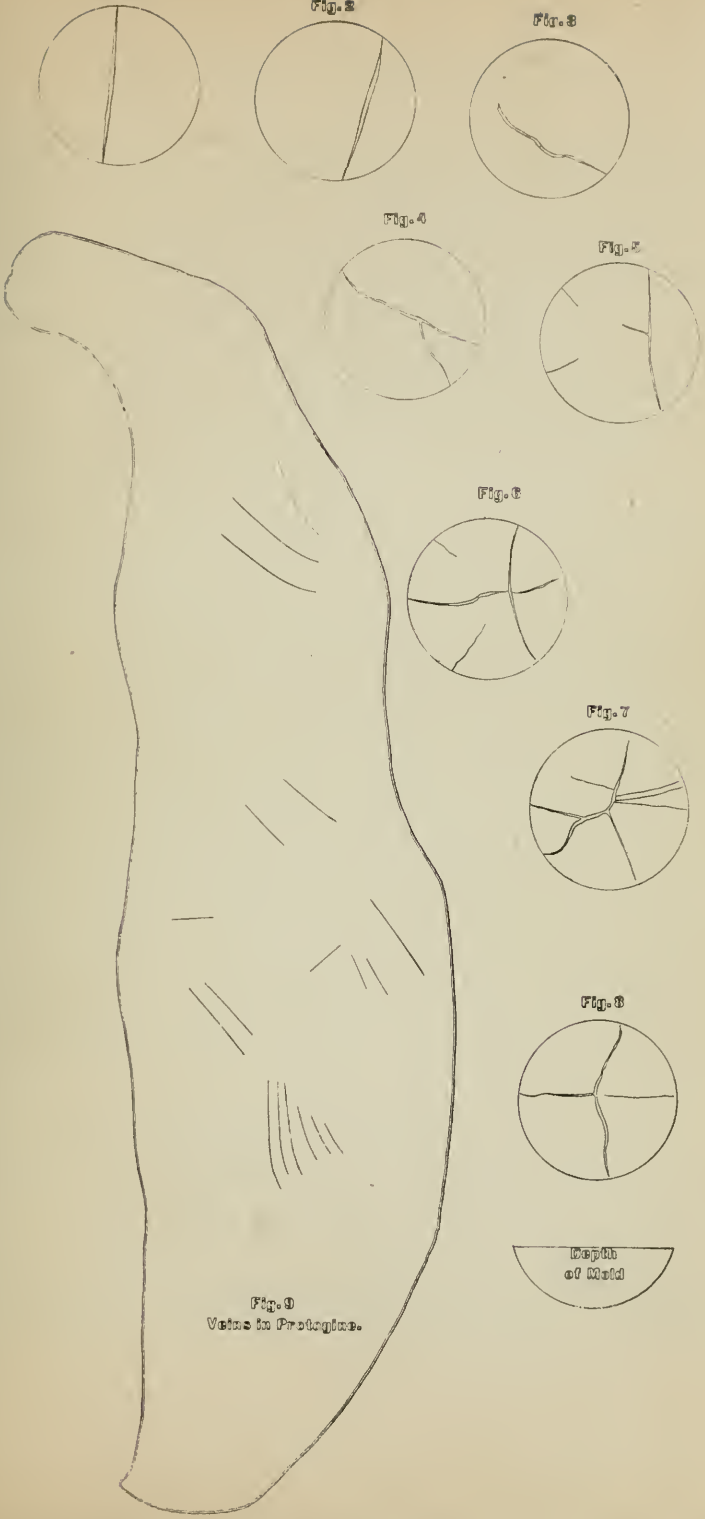

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9
Veins in Protogine.

bearing rocks, in the Thunder Bay and Nepigon Bay regions. The granite eruptions were undoubtedly the indirect cause of the filling of the fissures of our Huronian rocks. When the principal plutonic activity ceased at that time, that is, when the extravasation and injecttion of lava through and into the fissures of the rocks stopped, Fumaroles, Solfataras, and Mofettes in or near the craters followed, and the thick, hot, moist air which must have existed at that time took up their fumes and gases and precipitated them very soon again, whence they were carried away by the waters. Now these waters in flowing in the fissures, or in percolating through the interstices or capillaries of the rocks, came not only at or near the surface in contact with those gaseous products, but also in the lower parts of the vents of the craters, or along dykes, and apophysis, and were forced up from these hot places as thermal springs and geysers. But where the column of these waters stood too high and in consequence too heavy in the vents or rock fissures, the mineralized water would not have reached the surface at all, but forced in the lower fissures of the rocks as plutonic or baryspheric waters. Now when we consider the relative nearness of the fiery interior towards our earth's crust in those times, the fumaroles and solfataras must have not only brought up sulphur or haloid gases, but also combined with them metals in gaslike form which like the others were taken up by the waters and carried on till they found in their course a precipitant and were deposited, or the hot saturated solutions reached a fissure in a cooler rock stratum where the contents crystallized out of them. Also sublimation has to be considered, and especially in impermeable rocks in which through a later fissuring or any other dynamic action the water had access to these deposits, dissolved and distributed them in the fissures.

These processes of depositing minerals have to be classed under the ascention theory; but in certain instances lateral secretion has also to be considered, because there are undoubtedly cases in which the country rock furnished at least a part of the contents of veins. That is, the circulating mineral waters percolated through the fine pores or little fissues of the rock, dissolved the minerals which were contained therein and deposited them again in the open spaces of that or a neighbouring rock. By superficial observation we might come to the conclusion that also the fahlbands had been mineralized in that way, but by closer study we find that most of the slates and schists which contained those fissures and openings of which I spoke above, were filled with the contents of hot mineral waters which overflowed these rocks, because in most cases It would have been hardly possible to extract so much quartz or minerals out of these very basic rocks to fill all the open spaces therein; further we have to consider, the deeper we go into these rocks by mining the poorer it becomes, which would offer another proof.

I have considered above only one, but perhaps the principal cause how our slates and schists became tilted and fissured; that there must have been other causes is easily understood, but they are of no great importance here at present, because our most important gold deposits are not in these old rocks, but in a somewhat younger and often granitic rock, or are contact veins between these and the slates or even gneisses. Now I wish to be understood that I do not assert that there are no good gold bearing veins in our metamorphic rocks. Surely there are, but there are many more bedded veins. These like most others follow the foliation of these rocks, seldom that they cross their planes. This is different in the case of the veins in the younger rocks because we find them striking in all directions as I have shown in Fig. 9, and Saw Bill Lake map.

I come now to the description of two so far the most important gold deposits this side of the Lake of the Woods, and commence with the one situated at the lower part of the Seine between Shoal Lake and Bad Vermilion Lake.

The one acquainted with our regions will have observed that our most important gold deposits are usually in the neighborhood of eruptive rocks, of "post Keewatin" times, and especially near granite eruptions, as we can see in the Lake of the Woods, along the Seine River, Saw Bill lake, Moss Township, Greenwater lake, Shebandowan lake, and not less so in the region between Schreiber and Jackfish. Now this has also occured around Bad Vermilion lake and Shoal lake near Rainy lake; we see here in and on the south shore of the former lake the root of an immense volcano of post Keewatin time, represented by a mass of granite of three and a half miles in diameter. Surrounding this rock we find still the former corona or collar of the volcano consisting of a very basic anorthite gabbro which was formed by the first extravasation. Adjoining at the east we see another rock partly overlaying the former, which was once a granitic rock, but almost wholly changed into a protogine, as I have called it several years ago. This rock interests us here especially because we find in it the principal gold veins in that country. There exists a diversity of opinion in regard to its age, that is, if this protogine is the older, or the gabbro, but after a close field study and consideration of volcano characteristics, we soon should come to the conclusion, that the gabbro must be the older, but surely not the granite which was the last lava and forms now the root or filling of the former vent. Therefore it is also younger than the protogine, and why? Because we find intrusions of this younger granite in both gabbro and protogine. I showed here in a little sketch how we may imagine the volcano at the time of the extravasation of the lava of the present protogine which would harmonize very well with the configuration of the latter as we find it lying now between gabbro and conglomerate. It was also said that the veins in the protogine were formed through the pressure of the eruptive gabbro while breaking through the granite. If this were correct we would see the apophysis, or also called dykes, crossing the protogine, consisting of gabbro and not of granite; further we would see the veins radiating from the west and southwest, while they radiate from the east and southeast, as I showed it on accompanying drawing, Fig. 9. I said in a former paper that the fissures in this rock were undoubtedly produced by its contraction while cooling, radiating to that part where the lava was thickest and cooled most slowly, and I can add here, may have widened and increased in number by the pressure and intrusion of the granite eruption which filled the few fissures striking westwards to the eruptive centre of the volcano. These intrusions have disturbed the present vein fissures somewhat, that is, have thrown them in several cases 10 to 20 feet out of their course, but usually the later coming solutions have cut the dykes which seldom were in the protogine wider than 10 to 16 inches.

We come now to the question, by which process were these fissures filled? In considering the great number of veins in this rock, and the great difference in their filling in regard to economic minerals, and also in regard to the mode of filling, we have here perhaps both the above mentioned processes to consider which were active at the same time, that is, the filling through ascending mineral waters, and also by secretion through the pores or capillaries and interstices of the rock, and thereby a lateral filling. We find two classes of veins in the protogine, one which is heavily mineralized with sulphurets with little and again with much gold, the other with only a few sulphurets, but a good deal of free gold. One class again with absolutely no stratification, while the other very regularly stratified. The cause for this might have been that a certain number of the fissures had no communication with the ascending waters while others had; the waters from the latter were forced through the rock, changed the mica, leached its contents of minerals out of it, and deposited them in the last class of fissures, leaving at the same time a certain amount of the sulphide of iron and copper in the rock, which we find to-day in there fossilized as pyrites. If this explanation represents the exact mode by which these veins were filled cannot be decided with certainty, because our knowledge of these processes for each instance is still too limited, but in drawing the resume of our observations and studies of the geological and chemo-mineralogical occurrences, we might come to the conclusions above mentioned.

Now, gentlemen, from what I have said above in regard to the veins in the protogine and their genetic relation to the Bad Vermilion volcano, you will have recognized that they are all good true fissure veins, and as far as development work has shown, also very promising for a profitable mining.

But now it is time to leave this very interesting region and travel up the Seine where we pass several similar occurrences of gold deposits. However, before we leave this river I would like to make you acquainted with a small extinct volcano and its wonderfully preserved crater of post Keewatin or perhaps Cambrain times. This volcano is situated at the extreme point of a cape on the lower part of Steep Rock lake, projecting only 150 feet above the lake, and forms there, as seen from the distance, the end elevation of a chain of hills striking to the north-east. The outer walls are in this direction very much eroded and perhaps also plowed away by passing icebergs, so that we see now the former more interior part of the wall, consisting of the breccia of different kinds of rocks, brightly burnt red by the fiery lava which was once emitted from the vent. There is only one place at the south-east side where it is possible to climb up to its sides and top, up a very shallow steep depression. Halfway up the crater we come to an opening about 3 x 5 feet, looking at first like the entrance of a cave, but as soon as the eyes become more accustomed to the dark interior we see the smooth walls of a vent of irregular eliptic form of about 24 feet in its largest diameter. Smooth as the walls are around us, so they are also in their vertical course downwards, till they strike in nearly 70 feet water which stands in there almost level with the niveau of the lake. These walls are indeed as well preserved as if the lava had quite recently receded downwards again, only a thin effloresence of a calcareous and fluoric matter covers the walls like the dust in an old abandoned coal drift; otherwise they are completely intact. In its later years of activity this crater must have served as the vent of a geyser, because not only the breccia of the walls is cemented together by calcite, zeolites and baryte, but we see these minerals also distributed in the fissures of the surrounding rocks. The interior of the crater owes its preservation to the falling in of its corona which formed an arch over it, and protected it thereby against atmospheric influences. The largest part of the rock breccia consists very likely of an andesite, but it is so much burnt and altered that their determination is rather difficult. Quite a number of such small craters can be seen on Steep Rock lake, easily recognizable by the red color of their walls, but none shows its interior so well as the above described. The ejections of calcareous, fluoric and barytic minerals at those times would give us also an indication how the calcite veins of our silver mines are filled, if the former thermal springs in our silver bearing rocks had stopped flowing. But they show us also how great the activity of geysers has been after the volcanic activity stopped.

Such conditions have also existed around the east shore of Sawbill lake not very far north from the former lake. Unfortunately I am not able to speak about the geological condition of that part of the country so positively as I wished, because my time while I visited this gold belt was always too limited for a close investigation in regard to the relation of the different rocks to one another. Notwithstanding this I could not resist giving you, gentlemen, a short account of the great size of some of the gold deposits which occur there.

As I mentioned above we find also here the intrusive granite, which as we have seen has played such an important role in the depositions of gold in our veins. These veins are also here not in the older metamorphic schist or slates, but in a somewhat younger, which by microscopic examination appears to be a quartzeous diorite. However by a closer study of specimens taken from deeper workings and at a greater distance from the wide vein, we might recognize this rock as a very much altered granite. Unfortunately the result of a microscopic examination which I intended to have made, has not reached me on time.

In a country whose formation is so old and so highly eruptive as the Seine river and Thunder Bay Districts, it is not astonishing to find and see the manifold freaks which the plutonic forces have played in forming our earth's crust. How many times must the first hardened crust have been remelted. how many times the rocks of certain locations? We can trace this back even as late as Keewatin times, if we look at the gneisses and their rock enclosures. What a role have heat and chemical agencies played in the metamorphism of the older rocks! What the dynamic forces in altering and shaping our sphere! Pluto must have been a busy god while he was young, but sometimes reckless in tearing apart what he had formed as a whole, and if it would be only for making room for a few "fountains." And this he did at Saw Bill Lake.

I have shown above that the fissures in our metamorphic rocks were principally produced through the contraction of the gneissic magma; while those in the later eruptive rocks through the contraction of their magma, and seldom through a later eruption. This latter could have been produced only by the diabases, which followed the granite eruption, but there is no sign which speaks for such phenomena, because we see the neighboring rocks of these trap-dykes (as usually called here) quite undisturbed, perhaps dislocated here and there somewhat, but they caused no tilting, as the contracting gneisses, or some plutonic intrusions of granite. Indeed the argillites through which the diabases became eruptive are not more moved than 5, sometimes 10 degrees from their former horizontal position, and then even it is questionable if the traps did it, or the later movements and lifting of several of our hills, Thunder Cape, Macay Mountains, Pie Island, etc. We have to come therefore to the conclusion that the fissures and rents in the rock on Saw Bill Lake were principally caused by contraction. When the magma had solidified but not cooled yet this rock formation was split by an immense rent, separating it nearly in two halves, that is, the tension in the rock must have been equally strong towards both sides. This phenomenon is easily repeated in the laboratory by pouring a crucible full of an acid slag not too liquid in a shallow mould and allowing it to cool slowly. We see in this experiment a wide rent passing through the middle or near the middle of the slag, as I have shown in the accompanying little sketches Fig. 1 to 8, which are taken from a number of experiments. We see here as well, as in the Saw Bill rent, that where the lava or slag was thickest the opening is the widest, while thinnest towards the ends; and where the cooling was much retarded the fissures showed not the same width, while on the other hand when moderately fast they became wider and were naturally also formed more quickly. Map 2 shows the Saw Bill vein and some of the measurements; you will observe that it is of an immense size, and surely worthy of attention; the more so as its fillings promise a very profitable mining. The components consist of quartz and chlorite intermixed in the way I have shown in Fig. 10, by which you will notice that they are idio-genetic products, that is, had the same origin and were formed at the same time, but solidified perhaps by molecular attraction, the quartz by itself in smaller and bigger lumps, and so also the chloride, surrounding the former. They are also mineralized at the same time, with gold free and combined with chalcopyrite, but both usually in very fine particles, on some places in large quantities, on others less so, but always of very encouraging richness.

As you will notice on the sketch, there are a number of other smaller but pure quartz veins, mineralized with copper and iron pyrites, galenite and some sphalerite and gold free and combined with the former minerals. These veins strike not only towards the big vein, but can also be traced to its immediate neighborhood, but unfortunately lose themselves there under heavy cover. Now we may ask, why is it that these veins do not contain chlorite mixed with the quartz, as does the big vein, and why do they contain galena and blende, and all other minerals in much larger crystals, and why not so the big vein? The answer to these questions would be: the different classes of veins in this rock are filled at different times and with different solutions. On closer study we have to come to the conclusion that the small quartz veins must have been filled first, because if the contrary would be the case, they would have the same constituents as the bigger ones, that is, chloride and quartz, and not quartz only. Again if these small fissures were of later origin than the larger, we would see them not stopping right in front of the former, but these fissures would have crossed, that is, extended surely over and beyond the wider deposit, because the filling would have acted as a cement between the two walls and had yielded with the rock. No, the fissures may have been produced at the same time, but not their fillings. Perhaps you may say that the process of filling could have been going on at the same time owing through the different pressure and temperature of the solutions in those veins. Or that the present filling of the big lode might be a secondary product. But also these hypotheses could easily be disproved. In my opinion the small fissures were first filled, very likely soon after the granite eruption, while the bigger one later through hot geyser waters, containing silica, magnesia, iron and copper sulphides with some gold in solution. These geysers must have been enormous, not only to fill a fissure several miles in length and considerable width, but also to force these solutions into tbe surrounding rock, in which we find to-day the same minerals as enogenitites disseminated throughout, but especially so for several feet into the adjoining walls. Another occurence which led me to conclude that geyser waters were the cause of filling, is, that we find here and there the ore in horizontal shale like layers and not in vertical crustifications as are often seen in veins filled by secretion. As I said above the adjoining rock is so completely changed that I was first led to believe it to be a quartzeous diorite heavily mineralized with chalcopyrite. This part shows at the surface a thick coating of hydro-ferric-oxyd which gives it the appearance of the miners well known "iron hat." The walls between the lode and country rock are well defined, and the ore breaks from them as smooth as could be desired.

There are a few more such deposits in this rock striking towards the large vein of which I have examined only two, but I should not be surprised to hear of a number of similar veins being found next summer, as soon as that part of the country is more thoroughly prospected, and the prospectors are more accustomed to distinguish these quartz deposits from the country rock. Should this be the case, and only half of the expectations be fulfilled, which the owners of the land have a right to cherish on account of the good surface indications, then I have no doubt that the Saw Bill Lake region will be one of the principle gold mining camps, not only in Western Ontario, but also of the whole Dominion

If I did not feel, gentlemen, that I had tried your patience too long in listening to this paper, I could have added here some more items for a better characteristic and for a better acquaintance with our Western Mineral deposits, especially for the benefit of those of you who are less familiar with them, but I shall spare this for another occasion.

In conclusion allow me to thank you, gentlemen, for your kind attention.

A New Use for Scrap Mica.

By Mr. H. C. Michell, Toronto.*

The new use for Scrap or Waste Mica which I have been asked to describe this evening, is at present confined chiefly to its manufacture as an insulator of Steam Heat, although it can also be applied for other insulating purposes. It will be well at the outset to define what is commonly termed Scrap or Waste Mica.

As you are all aware Mica is found in irregular shaped crystals in almost endless variety of size and colour. It is one of the most perfectly foliated of all minerals, the laminæ being so delicate in many specimens as to require the almost incredible number of 300,000 of them to form a thickness of one inch. The Mica crystals are more of less seamed or cracked, so that often an apparently perfect crystal when split open, parts and subdivides into a number of small fragments. This unfortunate characteristic has really been the cause of much of the disaster which seems so often to have dogged the steps or mica mining in this and other countries. It is bad enough to have to deal with any mineral which occurs in pockets which pinch out without warning, and which leave no particular indication or lead as to where it may be found again. If all the deposits of mica which have been found in Canada had produced crystals more or less free from cracks and flaws, most miners would have been content with their strikes, and would not have been so much concerned as to whether or not it was a pocket or a true fissure vein. Then again many deposits of mica disclose a large proportion of crystals twisted and destroyed to such a degree as to render their cleavage almost impossible. These, together with the fragments already referred to, find their way to the dump, having thus far served no other purpose than to add very largely, and in some cases prohibitively, to the cost of mining the merchantable article. We shall, however, resurrect them presently, and I trust be able to demonstrate that instead of a loss, this hitherto costly waste may become a valuable by-product of mica mines. The proportion of waste or unmerchantable mica in every ton mined is very considerable. I do not know that the percentage of it to the ton has ever been approximated, but the evidence of a large number of miners would seem to indicate that it would average not far short of 70 per cent. of the total product. There are many instances I am aware where the average waste per ton is considerably less, but there are also as many cases where the percentage is as much higher, so that I think I am justified in venturing that estimate It will be readily seen then that mica miners have had to contend with a very serious problem in the matter of this abnormal amount of refuse, and they have heretofore been unable to reckon upon a return of any kind for almost three-quarters of their total output.

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* Paper read before the Ontario Mining Institute, April meeting, 1897.

So far I have referred to mica in general, but now we must notice the particular groups of it in Canada. These we may determine chiefly by the variety and color of the material. There are as I have said almost innumerable variations of colour and shade, from the nearly pure white to jet black, muscovite and phlogopite, but for general purposes we may divide them into three groups—White, Amber and Black. White mica appears to be very scarce in this country as compared to the quantities of amber and black, and as it is almost perfectly transparent, it has always commanded a much higher price than the other varieties. I may say, too, in speaking of white mica that there is a value for the waste of scrap of it, as when pulverized it has a beautiful lustrous appearance which lead to its being utilized for wall paper silvering, and other decorative purposes. As however it does not appear to have been discovered in anything like the same quantity as amber and black in Canada, it has not as much interest to us as the commoner varieties. The great bulk of Canadian mica is included in all these shades of amber, silver, red and brown, which range from cloudy or milk white to dense black, which latter as far as I know has no value whatever. I now come to this new use for waste mica. Although we can use the refuse of nearly all these varieties, excepting badly twisted crystals, it is the soft amber and light brown micas which we prefer for our purpose. This is fortunate for all concerned, as it appears to be the most abundant. We find that by taking these scraps or waste pieces and subdividing them as finely as possible, and then quilting them between galvanized wire netting, that we produce a fireproof mat, flexible clean and a magnificent non-conductor of heat. It will be noticed that all these flakes are ribbed or corrugated, the object being to increase the number of dead air spaces in the mat, and also to add to its bulk without increasing its weight. The finer we are able to divide these flakes, the more effective they become, as each one in itself is a splendid non-conductor, so that the greater number we are able to get into a given space, the higher the results are in checking the escape of the heat waves.

It will be seen that these mats or quilts are not only fireproof, but very flexible and elastic, which is a most valuable feature as they will expand or contract with the iron they cover without cracking or flaking off. No doubt many of you have seen boilers covered with some of the old fashioned cements, which being put on wet and allowed to set hard, often crack and split to make room for the expansion of the material beneath. In time it will loosen and fall off and require constant patching to keep in order. The real value however, in making these mats in sections, is that they can be removed whenever it is desirable to examine the shell of the boiler, and can be replaced easily and quickly without injury. As you will notice they are secured to the boiler by means of hooks attached to iron bands which are passed round the boiler under the mats. Besides this covering for boilers, the waste mica is made into sectional covering for all sizes of steam and hot water pipes, the only difference being that the mica is stitched between a wire core which fits the pipe, and an outer covering of canvas. The sections are secured to the pipe by lacing around the boot hooks which are rivetted up the seam at convenient distances. Covering for all sized and shapes of fittings including Elbows, Tees, Crosses, Globe Valves are also made and secured to the iron in the same way. These have been difficult to make owing to the intractable character of the mica flakes themselves, as being very elastic, it was found hard to bend them to the various shapes. We found the same difficulty in making the flakes bend around the smaller sizes of pipes, but finally succeeded by separating them into different sizes, in the same way as coal is graded, the larger flakes being used on the larger sizes, and so on down to the small half inch-pipe.

Perhaps I may be allowed to refer here to the not unnatural idea that using the mica in this loose dry form it would be liable to shift or sag in the wire netting or canvas case. This however, is not the case, for the reason that the flakes being of irregular shape with rough edges and ribbed surfaces, they catch and bind one another, matting together as hair does. As a proof of this I may say that after nearly two years in constant service on locomotives where there is probably heavier and more constant vibration than is found anywhere else, the mats have been found in perfect condition, and in the opinion of railway engineers, are likely to last an indefinite number of years.

Before passing on to the probable effect of this new use for waste mica on the mining of the mineral in this country, Imay be allowed to refer to some of the expert trials which have been made of the manufactured material. It is obvious that unless the results obtained from the use of this new non-conducting covering are really substantial and beyond question that the efforts now being made to establish a new use for mica must fail. Fortunately however, there is no longer any doubt or uncertainty on this point, and I believe I am justified in asserting that we have discovered absolutely the highest non-conductor of heat in the World, which can be used commercially, and that there is no substance used in the United States or Great Britain which equals this new insulator. It is no small satisfaction to think that it has been brought into use by the enterprize and pluck of Ontario men, and that there appears no reason to doubt that the mines of Canada will be able to produce sufficient of the raw material to permit of an almost unlimited expansion of this new industry on the markets of the world. How vast this market is may be imagined, when I remind you that every locomotive in use the world over, has to be protected with some substance; that every steamer that puts to sea has boilers which require hundreds of tons of coal to feed them, (in one of the great battle ships of Great Britain lately launched, there were no less than

48 of them), and that every stationary steam plant has a boiler or a battery of boilers, which require covering to minimize the loss of steam and power by radiation. How great this loss is few manufacturers, or indeed engineers seem to realize. As you of course know it is occasioned by the condensation of steam, that is, you allow the steam which you have generated often at great cost of fuel to cool off and condense by allowing the surface of the boiler and pipes to remain exposed to an atmosphere many degrees colder than they.

With steam at 75 lbs. gauge pressure, it has been estimated that the loss of horse-power on different sized pipes uncovered is about as follows:—

2	inch pipe	1	Horse Power lost	for every	132	feet long
4	"	1	"	"	75	"
6	"	1	"	"	46	"
8	"	1	"	"	40	"
12	"	1	"	"	26	"

So that when you complain that you cannot get power out of your engines or that the boiler seems too small for the job, you may solace yourselves with the thought that it is very often because you don't know enough to keep your steam dry! An argument often heard amongst mining men is that as many of them use wood for firing their boilers, it is not so much consequence if it does take a little more of it to keep up steam. Suppose that is true, it is difficult to believe that it is wiser to tie down the safety valve and pile in wood to carry steam through long runs of pipes than to remove the necessity and expense of doing so.

FIRE PROOFING.

Another use for this waste mica is for fire-proofing. Mica, like everything, will fuse if there is heat enough, even "the elements will melt with fervent heat," but it will stand an almost incandescent heat without injury, and for that reason it is a very valuable substance for fire-proofing. Considerable quantities of it have been already used for protecting smoke flues, kilns, &c., and in some factories the fire underwriters have reduced the premiums after the flues have been insulated with mica. In this connection it is not without interest to refer to the fire risk in some mines from unprotected steam pipes. I have heard that a serious fire occurred in a mine lately in Canada, which was directly attributable to a live steam pipe which ran in close contact to a wooden sheeting or boxing, and which subsequently took fire. It is very questionable whether a fire could be started from steam heat alone, but it is perfectly certain that wood may become so charred and calcined from contact with a live steam pipe that a drop of oil or grease falling on it would quickly cause combustion. So that here again we find a use for mica. I cannot refer in detail to all the other actual and possible fields of usefulness for this hitherto despised waste product of our mica mines, but I must not leave the subject without touching on its qualities for resisting the other extreme of heat, namely frost. It is said extremes meet. They do in this instance, for the identical covering made for fire-proofing gives splendid results in frost-proofing, and I have no doubt at all that mica will shortly be used for insulating cold storage chambers. Being free from organic matter to mold or smell, it is not liable to taint even such susceptible commodities as milk or butter, which is not the least valuable of its advantages. Such are some of the uses to which we are putting waste mica.

As those interested in mines and mining,. you will doubtless enquire what effect this discovery is likely to have on the mica industry in Canada. This altogether depends on the demand. If it increases as it is doing now (the sale of it advanced 98 per cent. last year), very large quantities indeed will be required. In that event we shall be able to pay better prices for it, and we shall be glad to do it. I believe the most successful industries are those whose produce are profitable to the customers, thé manufacturers, and to those who sell the raw material. But so long as we are expected to sell as cheap as the cheapest without regard to quality or value, so long will we be forced to buy at prices which have no regard to the living wage of miners. Buying in the cheapest and selling in the dearest market is a phrase well enough in theory; for my part I would like to see the demand sufficiently large to justify us in paying prices that would start every pit in Canada, and make every mine an indirect source of general revenue to the people, in whose prosperity the success of our business depends.

. I do not know that we can expect quite such fortune as that, but I do believe that while this new industry may not justify mining solely for its requirements, yet every ton of waste or refuse used in it, means so much less cost of mining, and so much more profit in the year.

It should make a considerable difference to the expense of mining, if in the future it is known that by simply laying aside in some protected place the waste and scrap which has hitherto been consigned to the dump, a certain amount of revenue may be earned which will lessen the general expense of mining. In conclusion may I express the hope, which does not emanate entirely from the selfish standpoint of the manufacturer, that the progress of this new industry may be such as will result in such an increase of the demand for waste mica as will make the discovery of this new use for it profitable to the miner and manufacturer alike.

The building up of industries in Canada which use as their base raw material produced entirely in this country, must be of ultimate benefit to the general community, and I think we must all deplore the conditions which appear to result in so much of the raw material of this country being shipped out of it, to benefit the towns and villages of the countries in which it is manufactured. We must recognize the enterprise and pluck of foreigners who come to this country and develop our latent wealth, but we must also deplore the fact that it often results in the larger profits of the enterprise being carried away and spent amongst other peoples. The profits of much of our Nova Scotia coal mining are not unappreciated in Boston; the great lumber mills of Michigan know something of the value of Canadian logs; the paper pulp mills of the United States are not indifferent to the wood-pulp of British America, and even distant Spokane has associated the gold mines of British Columbia with many a new brown stone front in that city. Let us hope that this new use for waste mica may conduce to the prosperity of Canadians at home.

Some Notes on the Milling of Gold Ores.

By John E. Hardman, S.B.M.E., Montreal.

To the mine owner, whose property has passed from the stage of a prospect into that of a partially developed mine, the subject of the proper treatment of his ore is, perhaps, the most immediate, if not the most important, one he has to consider.

The rapidly accumulating evidence which Western Ontario offers of possessing large areas of free milling, or partially free milling gold ores, may make these notes I have to offer more or less valuable to some of you who are the fortunate possessors of lands carrying such ores.

The old distinction between "Free Milling" and "Refractory," gold ores is getting less and less sharply defined each year, owing to the progress made by metallurgists in their treatment.

Broadly speaking, a gold ore may be termed "free" milling if the *major* part of its gold value can be extracted by amalgamation with mercury; to be "partially" free milling if a considerable fraction (but less than one-half) of its gold can be extracted by crushing and amalgamation; and "refractory" when no part, or a very inconsiderable fraction, of its gold contents are thus recoverable.

For the treatment of free, or partially free, milling ores, the recognized steps are:—Fine crushing by stamps, amalgamation within the mortar and on the plates by mercury, and the concentration of the metallic sulphurets in the tailings by means of vanning machines.

Various combinations of these three steps or processes may be used to advantage, depending upon the nature and character of the ore, the gangue and the manner in which the bulk of the free gold is contained in the vein stone.

Various supplementary processes also, such as chlorination for treatment of the metallic sulphurets, and cyaniding for treatment of tailings with or without previous concentration, are employed by the competent metallurgist to extract the highest economical percentage of the gold contained in the ore.

The various methods of precipitating the gold from its solution, and the use of combined cyanides (such as the Bromocyanide process), are all details of the main steps in the consecutive treatment of a gold-bearing rock.

It is of importance, then, that a proper selection of a method or process should be made at the outset, before incurring any heavy expense for a reduction plant, since failure to recognize and adopt the proper process at the start may entail double expense on the owner or company through the pulling down and re-building of his mill, or, what is worse, and perhaps more frequent, cause the abandonment of the enterprise through failure to extract a remunerative amount of gold from the ore as treated.

It will manifestly be impossible to attempt to give you a full or complete account of all the varieties of conditions and of ores met with in practice, the limits of this paper will only permit me to note the outlines of the most prominent conditions.

In selecting the approximately correct process for milling a gold ore, comparatively simple tests at the beginning will show you whether your rock is free milling, partially free, or refractory.

A weighed *average* sample of your stone, about four pounds in weight, should be finely pulverized, and all of it passed through a 30 or 40 mesh sieve. Note whether any of the gold contained is large enough to remain on the sieve, if so, separate it and add it to what you obtain afterwards. Take the full four pounds, put them in an iron mortar with water sufficient to make the whole into a paste, and add from a teaspoonful to a dessert spoonful of clean mercury; then grind the whole mass vigorously together for half an hour, when a small lump of potassium cyanide may be added, not bigger than a 32 bullet, and grinding continued for ten or fifteen minutes more. After this pan off your pulp, taking not more than one pound at a time, and thinning it when in the pan with plenty of water.

The resulting quicksilver and amalgam obtained is then strained through a bit of soft buckskin and retorted, and this gold is added to what was obtained on the sieve. All the gold thus obtained should be weighed.

Save your tailings from panning and have them assayed. If you find that you have extracted the greater part of the gold by panning, the usual stamping and amalgamation process is the one indicated, and the value of your tails when concentrated to clean sulphurets, will indicate to you whether it is advisable to add vanners to your mill or not.

Should the test show that the larger value of the ore is not in free or metallic gold, but is contained in the sulphurets and tailings, then a sufficiently large sample (not less than one ton) should be sent to a testing laboratory for determination of the proper method, or the services of a competent metallurgist should be engaged to examine and test your ore.

In cases where the larger value of the ore is contained in the metallic sulphurets which occur in the vein, it has frequently been found advisable to crush such ore coarsely by means of rolls, and concentrate the sulphurets first, subsequently grinding the tails from concentration, either by pans or light stamps, and amalgamating them with Hg, following such amalgamation again by vanners. Care must be exercised, however, in considering this method, and in the further treatment of the concentrates, that the gold contained is not coarse, or "nuggety," else may occur the same disaster that many of you may know more of than I do—I refer to Deloro, where the tails from the roasted and chlorinated mispickle gave good returns of free coarse gold by panning and even by sluicing.

I can only say enough on selection of process to give you an idea of its importance, in order to have the first step made rightly, and to advise, in all cases, obtaining expert advice.

From what has been published, and from what I have seen of the ores of your great gold field, the usual method of stamping, amalgamation and concentration, automatically and in regular order will be the prevailing process employed—a few notes, therefore, on some of the machinery and its operation may be of value.

The design of the plant is entirely dependent upon local topography and circumstances, the idea governing such design should be to make the whole as automatic as possible, avoiding labor of handling, which is always the chief factor in costs.

The item then of foundations requires attention—the foundations of your mortars should always be of wood placed on end ; such wood may be large sticks, dried and well fitted, or of dressed plank spiked together, as circumstances and costs may determine, but always carry this wooden mortar-block to the *solid* rock, and do not have the length of the mortar-blocks less than 10 feet. There is a certain resilience or elasticity in wood placed on end which is not fully developed in lengths of less than 10 feet.

The foundations of your mill, engine and concentrators are of nearly equal importance ; for the former a solid bed of concrete, of the form of a truncated pyramid is advisable, for the latter, well weighted mudsills, braced to ensure stiffness and freedom from wracking horizontally, are desirable.

The prime motor of your mill, be it steam engine, water wheel or electric motor, should run steadily without serious variations of speed.

The best modern practice is not to put rock breakers on the mill engine, but to locate them at the shaft-house or rock-house and operate them by independent motors. When both concentrators and rock breakers are run off the mill engine, the variations of speed due to the working of the breaker cause constant attention to adjustments of the vanners and correspondingly poor work by them, and infinite annoyance to the mill man.

Whether the California " Knee frame " or the Dakota " Bin frame " for the superstructure of the mill is adopted may depend upon the idiosyncrasies of the designer : the pros and cons are briefly these—Knee frame—accessibility of line-shaft for alignment, ease of oiling and inspection, horizontal driving belt against a vertical one : *Cons*—less stability, more likely to get out of alignment.

Bin frame—greater stability, but dark, hard to keep free from grit and dirt, harder to oil, less accessible, necessitates tightener-pulley, wearing belt quicker, Choice of the wood to be used in the important parts of the frame, like the battery posts, binders, guide-binders and braces must be governed by character of the local timber and by cost. Where cost is not prohibitive, I have preferred of recent years putting in southern pine (long-leaved yellow pine), which never checks nor seasons to cause disturbance.

A question which has been frequently asked of me is whether two 12 x 12 in. posts may be bolted together to make a 12 by 24 in. post. There is not the slightest objection to joining two posts thus, provided you have a competent workman to fit the two surfaces together; the joint must be as perfect as possible, and the two sticks pin-dowelled together as well as thoroughly bolted.

I have used battery posts thus joined for over six years, and have never observed the slightest weakness in them nor any objection to their use.

In coming to the iron work of the mill, let me draw your attention to the use of friction clutch pulleys on the line shaft for driving the cam-shaft pulleys. In many years' use I have found them the most convenient, speedy and desirable device, enabling one to disconnect any battery quickly and without danger.

Of the materials from which the wearing parts are made, there is a decided tendency to replace iron by steel in every place possible.

The mortar remains of cast iron, of a tough, but soft character; the cam-shaft of mild steel, running in cast iron boxes made of a soft graphitic iron, I have found most satisfactory. Cams and tappet sare now almost universally made of a hard steel, such as chrome or manganese, and must be ground on wearing surfaces to a true smooth face.

Stems still remain of best wrought iron or ot mild steel, and heads or bosses are usually of the same material as the mortar, viz.: tough cast iron. As to shoes and dies, I need not specify, for I imagine you all have your preference. I may, however, add that very few small mills keep their records in such shape as to really know what is the cost of iron per ton of rock milled.

In ordering a new mill, it is of the utmost importance that your specifications should be clear and exact, and that you should know just what duty comes upon each part of the mill and provide for it. If you do not know, get your specifications *vise* by someone who does.

A device regarding apron-plates which is worthy of adoption is one permitting their adjustment to different degrees of inclination. This is particularly valuable when rock from two or more different veins is to be milled ; one rock may carry more clay or slate than another, and it is of advantage to be able to adjust the plate for the mortar in which such ore is being milled. For it is surely unnecessary to say, that stone from each vein should be milled in its own mortar, and not mixed with other stone. By this means only can one ascertain the relative values of rock from different portions of the vein, and locate approximately the limits of the pay chute.

Having such a mill, well designed and well adjusted, there are some few notes as to its daily running which may be of use.

As to the rock breaker, it is good policy to set this to crush to pass a small ring (one inch if possible) first, because the self-feeder runs with less attention, secondly, because the wear of shoes and dies is more uniform, and thirdly, because your daily capacity per stamp is much increased. Of course the limitation in this respect will have to be governed by the capacity of the breaker you have, but it is good policy always to put in a much larger breaker than the rated capacity of your stamps requires.

The introduction of the water to your mortar is also an item worth noticing. It should be fed from a tank with constant level, to ensure a uniform quantity per unit of time, and it is advisable to have this tank at a considerable height above the mortar, say 20 feet.

Instead of the old-fashioned faucets, one to each stamp, the better practice is to introduce a three-quarter inch pipe with straight-away cock between stems Nos. 1 and 2 and Nos. 4 and 5, making only two cocks to each 5-stamp battery.

A device which has been used in Ontario, and also recently in Nova Scotia, is the introduction of upward pointing jets of water from the base of the chuck block, one jet between each die, the advantage claimed being an avoidance of the hard packing of sulphurets between the dies, and consequently a supposed aid to amalgamation.

The matter of the height of the discharge opening above the top of the die is one which is directly dependent upon whether the stamp mill is used only as a crushing machine, or as a crushing and amalgamating machine combined, and also in the latter case upon the amount of, and manner in which, the gold is contained in the ore. For subsequent concentration, when the chief value lies in the sulphurets, a low discharge and coarse screen prevents much of the sliming which is fruitful of loss on the vanner.

Directly connected with this matter also is the speed and height of drop of the stamps, but the order in which stamps drop, other conditions being equal, governs only the matter of even discharge through the screen, and the even distribution of pulp throughout the mortar, so as to prevent banking and give each stamp a uniform quantity of work.

The preparation and introduction of mercury into the mortar is an item frequently disregarded, and productive of losses when not properly attended to.

Mercury as it comes in the flask is too dirty for use in gold amalgamation, and should be purified by retorting at least once. Whenever grease, oil or other fatty matter, or other substances like graphite, some sulphide ores like mispickel and partially oxidized sulphurets containing sulphates, like galena, are churned up in the mortar by the stamps, the mercury which has been fed becomes partially sickened or "floured" as it is called, breaking up into minute grey globules which do not coalesce, and which usually escape the trap and get lost with the tails. This loss usually entails a loss of gold also.

Naturally, the cure depends upon the cause:—if due to grease, the addition of small amounts of slaked lime, thrown into the hopper of the self-feeder from time to time, will usually "cut" the grease or saponify it and remedy the trouble; if, however, too much in quantity the addition of a stronger alkali is required. Screened wood ashes are used with good results in many caces.

If due to mispickel or the presence of much graphite, the addition of common salt has often been found effective, but some cases do not yield to such treatment.

Mercury should always be purified by retorting under a cover of quicklime, putting the retorted mercury subsequently into a large porcelain-lined vessel and covering it with a dilute solution of nitric acid in the proportion of one of acid to 4 or 5 of water. The mercury for the mortar and plates should be dipped out of the vessel and washed free from acid before using.

Another difficulty met with in the use of coppers which have not been silver-plated is the "verdigris" or green stain often forming in spots or streaks on the plates. This stain is due simply to the formation of oxy-salts of copper where the metal has not been thoroughly amalgamated with quicksilver. With care and attention these spots can be permanently removed.

Having thoroughly cleaned the spot to be attacked, dry it and scrape it with a blunt-edged chisel or other tool until the copper shows bright and clean, then thoroughly rub mercury into it with a piece of canvas, or chamois, moistened with cyanide of potassium solution; when well silvered, paint over the spot with a very fine gold amalgam, and let the amalgam set for 24 hours before using the plate again.

To prepare this very fine gold amalgam, it has been my habit to buy or acquire a bit of old copper plate well coated with gold amalgam, and by "sweating" this plate carefully over an ordinary kerosene lamp to scrape off the adhering amalgam, which is then put into a wedgewood mortar with a little quicksilver and well ground together; rapidly pouring off the mercury after skimming, leaves the coarser particles of amalgam behind, while the portion poured off if allowed to stand 24 hours, may be carefully decanted from the fine amalgam which has settled to the bottom, and which will be found to be of the consistency of cream, and admirably adapted for doctoring sick apron plates. It is advisable to always carry a small stock of this cream amalgam on hand.

I may also caution you against the lavish use of cyanide of potassium, which is detrimental to the plate rather than beneficial, if used in excess or too frequently.

Again if you would have clean plates, avoid the use of pit water which usually is acid and carries too much of dissolved sulphates and other mineral matter to give clean amalgamation.

The percentages of amalgam recovered in the mortar and on the outside plates are very various, differing with the design of the mortar and its appurtenances, with the regulation of speed and height of discharge, and with the character of the ore.

A free milling ore, treated in a gravity stamp battery of suitable design, can be milled so as to recover fully 90 per cent. behind the screen, *i. e.* within the mortar Many instances have been recorded by myself where the saving in the mortar has reached as high as 95-96 per cent. of the whole amount recovered.

The few cases in which a steam stamp has been used on free milling ores (whether of the portable type like the Gates or Tremaine, or the copper type—as at the Home-stake) seem to show that saving in the mortar is impracticable, due doubtless to the heavy churning and swash of the pulp in the mortar; in several cases this has been so great as to scour any inside plate used. I am, however, inclined to believe that this detriment to the small steam stamp can be removed by a simple change in the pattern of the mortar.

The main factors upon which the saving of amalgam within the mortar depend are:—

(1) The shape of the inside of the mortar,
(2) The height of the discharge,
(3) The character of the screen,
(4) The height of the drop,
(5) The shape and location of the inside plates used.

It would prolong this paper beyond the limits allowed, to discuss the influence of each of these factors upon the result, or to touch upon many other minor points of importance, which the skilled amalgamator usually regards as secrets of his trade.

And let me say a good word for the real amalgamator, the honest, patient, hard-working, watchful man who is continually studying his ore and his mill, and who takes as great delight in saving an extra half-penny weight from his tails as does his employer.

For the quack, who knows it all, who has some "Secret" device or some combination of chemicals that will save "105 per cent.," beware of him, and get him to leave your camp as quickly as his health permits.

I regret exceedingly that the limits of time prevent me from giving you many more items gathered during a somewhat extended period of 13 years, which might perhaps have been of interest. I shall hope, in the near future, to be permitted, by your kindness, to add perhaps to what I have said here, and perhaps also with the then added experience of personal acquaintance with parts of your great gold field of Western Ontario.

Moss Litter.

By Mr. T. W. Gibson, Toronto.

Agriculture and Mining are the chief members of a group of arts which lie at the base of all others, without which indeed none others could exist. Agriculture supplies the primal necessities of man by giving him food and clothing, and both together furnish him with raw materials for the wonderful and complex series of manufactures by which his ingenuity strives to gratify the tastes or satisfy the wants which seem to enlarge with his expanding civilization. They have both the same arena, the capacious bosom of mother earth, and both deal with the substances which are therein found. One enlists in her service those vital forces which seize upon the inanimate atoms of inorganic matter in air and soil and raise them from the mineral into the vegetable, and from the vegetable into the animal kingdom; the other has to do directly with the mineral substances themselves, and by the mere act of changing their situation and separating them from one another, rescues them from inutility and makes them subservient to the uses of man. One may be called an adaptive industry, whose processes if rightly directed, move in a circle, and appear capable of being conducted for all time; the other may be termed a destructive industry, dealing with large yet strictly limited quantities of material which once brought into play are forthwith subject to decay, and are scarcely, if at all, capable of being restored to their original condition. Agriculture and Mining touch each other at many points. The farmer feeds and clothes the miner, the miner warms the farmer, supplies him with fertilizers, keeps him in ploughs and harrows, and puts gold and silver in his purse. No market is worth so much to the tiller of the soil as a mining camp in full and flourishing blast. Miners usually want the best, and are quite willing to pay for it.

There are processes performed on the surface of the ground which in their nature seem intermediate between agriculture and mining, and to partake of the character of both. One of these is the reclamation of peat bogs and the utilization of the material of which such bogs are composed. As agricultural operations, such processes restore to cultivation considerable areas of land previously lying waste and barren, while viewed as incidents of mining, they convert to man's use actual portions of the earth's crust unchanged except by a certain amount of manipulation.

The origin of peat bogs is well understood. They are found chiefly in the colder parts of the globe, where evaporation goes on less actively than in the more tropical regions, and occur in low situations or where some natural or artificial obstacle impedes the drainage. The abundant moisture favors the growth of a low order of plants such as the sphagnum mosses, of which some fifty or sixty species are known. This plant is distinguished above all others by its capacity for absorbing and storing water, for which its peculiar structure eminently fits it. The epidermis of the stalk and the leaves of the plant are mainly composed of large empty cells, into which the water is drawn through a number of small holes. The cells are provided with rings or spiral-formed thickenings on their inner sides, which keep them from collapsing. They are consequently always distended, and always ready for use. Smaller cells occur between the larger ones, which contain chlorophyl and supply the plant with nourishment, but these occupy comparatively little space. The whole arrangement is that of an aggregation of reservoirs in successive layers, which are kept filled by the force of capillary attraction even when the plant itself is above the water level. It is curious to note that the properties of the sphagnum mosses which render them so well adapted for living in a low and moist situation, tend also to bring their existence to an end. They require a constant supply of moisture, yet they are continually pumping up to the surface of their tufts the water in which they stand, thus promoting its evaporation, and at the same time, by their constant decay, they deposit the detritus which adds to the solid contents of the bog. This process continues until the bog is raised above the level of the surface water, when the sphagnum vegetation ceases, having exhausted the conditions favorable to its growth. In process of time bogs of considerable depth are formed in this way. As the mass increases, decomposition takes place in the lower portions, and these become consolidated into a black or dark-brown earthy substance, which in some parts of the world is extensively converted into fuel. The usual method is to dig up the peat in cakes or blocks, and dry them by exposure to the wind and sun, after which they are stored and used as required. Hand labor is generally employed, though numberless attempts have been made to facilitate the process by the introduction of various kinds of machinery. The great difficulty in the economic employment of mechanical processes is the tenacity with which the peat retains the degree of moisture remaining after it has yielded up all that naturally evaporates in the air. Pressure and artificial heat have been resorted to to overcome this difficulty, but while the end aimed at is capable of achievement, it has usually been at too great a cost for economical results. A process which would put us in possession of a good and cheap peat fuel would be a great benefit to Ontario, destitute as the province is of workable beds of coal.

It is these absorptive properties of the sphagnum moss which have led to its utilization as litter or bedding for cattle, in lieu of straw or other materials commonly employed for such purposes. Its suitability for litter was doubtless recognized at an early date by people living in the vicinity of peat bogs, but it was as late as 1880 that the preparation of moss litter as an article of commerce was first begun by Hollman, at Gifhorn in Hanover. Since that time it has come rapidly into use in the countries of continental Europe and in Great Britain, as well as to some extent in America. The advantages claimed for the litter are that it affords drier and healthier bedding for horses and cattle than any other material; that by reason of its great power of absorbing moisture it binds the valuable portion of the animal excrements and consequently yields the best manure, that it acts as a disinfectant and improves the air of the stable, and that a smaller quantity of it is required than would be needed if straw were used. Experience in the use of litter in Euorpean countries seems to show that the claims made for it are well founded, and that it is the best article for the purpose yet introduced. The cells of the sphagnum moss in its manufactured condition retain very much of their power of attracting and holding water, and the litter in consequence is able to take up ten or fifteen times its own weight of moisture. It has the faculty of absorbing gases as well, and hence fixes the ammonia always present in greater or less degree in the atmosphere of buildings where animals are confined and fed. The soft, springy, elastic moss litter forms a more comfortable bed for cattle than straw, and greatly facilitates the task of keeping the animals and stables clean, a fact which has an important bearing on human welfare, as in the case of milk cows whose product is used as an article of diet. Careful trials of moss litter in army stables in Germany where straw was formerly employed showed its superiority in the following points: dry beds, dry fresh air free from ammonia, and the ceilings, walls and leather trappings remained free from moisture and mould. If proper care were taken to remove those portions of the litter which became charged with moisture, to shake it up every day, and fork it from one part of the stall to another, the horses found their quarters very much improved. Their skins remained clean and in activity, catarrhs of the nose and eyes, generally the result of bad air in stables, were less frequent, wounds on the legs healed more speedily, colic was almost eliminated, inflammations of the glands seldom ocurred, and rotting of the frog was almost entirely prevented. In cases of contagious disease, the litter proved of great value and surpassed all other disinfectants. In other cases, too, moss litter mixed with superphosphate has had the effect of protecting cattle from foot and mouth disease even while the infection spread to an alarming extent on neighbouring farms. This property would doubtless make it valuable for use in railway cars employed in the transportation of live stock. Many cases have been known in which disease was introduced or spread by cars in which infected animals had been carried. The manurial value of moss litter after it has served its purpose in the stable is greater than that of straw, for the reason that there is less evaporation of the liquid and volatile constituents. It would appear that no greater proportion of the potash, lime or phosphoric acid is recoverable by means of the litter, but the easily soluble nitrates are retained to a much larger extent than in the straw, which allows of their escape in the form of ammonia. As the agriculturist well knows, the nitrogen thus rendered available for plant food is a most valuable element of manure. In the manufacture of moss litter, as carried on in Europe, a fine dust is sifted out at a certain stage of the process, which, as well as the litter itself, is used as a deodorizer and absorbent of sewage and fecal matter, especially in small towns or cities where there are no proper systems of sewerage or drainage. Accumulation of noxious matter of this sort often gives rise to epidemic and infectious diseases. The employment of moss litter and peat-dust not only remedies this evil, but actually transforms deleterious waste into a valuable fertilizer. The absorbent properties of the litter check the growth of bacteria and retard the decomposition of organic substances. Fresh fish, fruit and vegetables are all said to have been preserved in excellent condition for a long time by being packed in peat moss. There are many other uses to which moss litter is put, such as raw material for coarse textile fabrics, a non-conductor of heat or noise in house building, paper-pulp, etc.,with more or less success.

The peat bogs of Canada, and of Ontario in particular, are of great extent. By virtue of their vast stores of carbon, they constitute a potential source of fuel supply to be made available when the right process of manufacture is invented and applied. Meantime a beginning has been made in the utilization of these bogs in the manufacture of moss litter. In the townships of Wainfleet and Humberstone, between the feeder of the Welland Canal and Lake Erie, about five miles from the town of Welland, lies a peat bog of some 5,000 acres owned by the Canadian Peat Fuel Company. At the northern edge of this bog the company has erected a plant for the manufacture of the litter according to a process which, in some respects, differs from that prevailing in Europe. The upper layer of the bog consists of undecomposed sphagnum moss varying in depth from 18 inches to 4½ feet, is said to be free from sand or other inorganic material, and to be well fitted for litter. The works have been erected and put in operation, and a considerable quantity of product turned out. The first stage of the process is to drain the bog by cutting trenches in it, and so allowing the surface to become sufficiently firm to enable the workmen to go upon it. The upper or undecomposed layers of moss are then cut into pieces about 18 inches square, which are piled together into rows and exposed to the sun and wind. When the moisture has sufficiently evaporated, these blocks are gathered and wheeled in small cars over a portable tramway to the factory. The first operation there is to pass them through the picking machines, two of which stand side by side. These are provided with heavy revolving cylinders, armed with strong teeth which act upon similar teeth set in the concave surface of a breast against which they work. In the pickers the moss is loosened and torn apart, the object being to separate the fibres rather than break them. The moss is discharged upon moving carriers, three in number, ranged above each other, which carry the moss horizontally through a drying passage or tunnel 116 feet in length, 8 feet high and 16 feet wide. These carriers travel against a current of hot air drawn through the tunnel by a disc fan revolving at the farther end, the object being to remove the greater part of the moisture remaining in the moss. The heat for this purpose is generated by a furnace situated parallel to the tunnel whence the hot air is drawn by the suction of the fan into a mixing chamber, where the temperature can be regulated at will by the admission of cold air. The hot blast after passing over the moss emerges laden with moisture into a wooden shaft and so into the air. At the end of the drying tunnel the moss falls into a conveyor from which it is elevated into a weighing bin or hopper situated above a baling press or packer. The hopper works automatically, and as soon as a sufficient weight is received, it deposits its load in the press, which is a machine of peculiar design worked by steam power. On a revolving circular platform are four stout wooden moulds. In one of these, wooden slats are placed to assist in securing the bale after it is pressed; it passes under the press, a workman above moves the lever, and a plunger descends with a pressure of 200 tons, forcing the moss firmly into the mould. The platform makes a quarter revolution, and while the second mould is being filled, number one is being tied firmly with wire, and at the third turn the finished bale is removed ready for shipment. The weight of a bale is 250 or 260 pounds. A knuckle-joint press is subsidiary to the steam press, but it is seldom required. The bales are then stored in sheds whence they can be shipped as called for over the Michigan Central Railway, a spur of which runs into the property.

In the finished state the litter contains about 30 or 35 per cent. of moisture. It is said to take up liquids more readily in this condition than when the cells of the plant are completely deprived of water, and is not so easily broken to pieces under the feet of horses. The output of the factory is about 40 tons per day of 10 hours, but can easily be increased. The consumption in America is about 18,000 tons a year at the present time, which hitherto has been imported exclusively from Europe. New York, Brooklyn, Baltimore, Philadelphia, Chicago, and other large cities are the chief places of use in the United States, but the market for litter is rapidly growing. It is employed in the stables of milk and transportation companies, liverymen and other large owners of cattle and horses, and even in the stables of many private individuals.

The Canadian Peat Fuel Company has entered into a contract for supplying an average quantity of 22,000 tons per annum for five years to parties in the States. They do not anticipate any trouble in marketing this quantity. One difficulty in the way of a more general use has been the cost of storing cargoes at the point of importation. Moss litter is a bulky article, and the rates charged for storage are high. They will be evaded in the case of the Welland factory, as the litter can be kept on hand there, and shipped only as required direct to consumers. The price at which it retails in New York is $15 to $18 per ton. In London, England, it sells at 35 shillings per ton.

The factory at Welland is the only one of the kind in America. The machinery used in it is from the designs of Mr. A. A. Dickson, the president of the company, and is patented in Canada, the United States, Great Britain, Germany, and other countries of continental Europe.

Beneath the layer of moss suitable for litter on the Welland bog lies a very large quantity of dark, decomposed peat, which it is the intention of the company to manufacture into fuel. The depth of this peaty section varies from a foot or two at the edge of the bog to 20 feet in the centre. The process of converting the crude peat into fuel is also one patented by Mr. Dickson, and as now perfected, does away with artificial heat. The peat is cut and air-dried, after which it is pulverized by being passed through a picker and deposited automatically in a hopper which feeds a steel tube about two inches in diameter and fifteen inches long. The pulverized peat is forced through this tube by pressure and formed into cylindrical blocks about three inches in length, and almost equal in density to anthracite coal. This part of the business has not yet been brought into operation.

Below the bed of peat lies a deposit of clay which experiments have shown to be of fine quality for the manufacture of vitrified brick, pottery, etc. The prospects is that a very large business will be built up by the company in the manufacture of moss litter, and perhaps also in peat fuel. In the utilization of such dormant resources they are really adding to the wealth of the country, and whether they can command success or not, they certainly deserve it.

A Few Notes on Material Used in Mining Machinery.

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By H. W. DeCourtenay, Montreal.

Last fall while on the way to the coast, I had the pleasure of stopping at several of the prominent mining districts, Lake of the Woods, Trail Creek, Rossland, Slocan, etc.

I was very much impressed with the fact that sooner or later a large amount of machinery would be required for the development of these districts.

In some of these districts many propositions will show up what are known as "Free Milling," and such being the case a great deal of machinery for this class of ore will be required.

The Lake of the Woods has presented some of this class, and also in certain districts east of this.

In British Columbia there are already several mines of this character. The recent showing from the LeRoi ore put through the stamp Mill with certain results, and the work of the O. K. Mine at Rossland, tend to show what may be done in that district. The Cariboo Mining & Milling Co., in Okanagon Section also has been demonstrating results on this kind of rock.

In the Lillooet district and on Vancouver Island, free milling propositions are also found, the same in the Cariboo district, which at present is largely placer, but already prove the necessity of ultimately requiring other machinery than hydraulic to get out the full value of the properties.

Referring to these probable requirements the source of supply must be from the East as very little manufacturing is done in the West, and none of that class adapted for the purpose, as air compressors and drills, rock crushers, stamp mills, pumps, etc.

With these vast fields before us stamp mills will be required and the desire will be to obtain the best appliances, of latest and most improved patterns.

To properly equip such plants, the machinery should be built to certain specifications and of certain materials and requirements of each individual part, in order that uniform working in every part may be the result. This all should be done under the supervision of a thorough practical Mining Engineer so that the plant will do the work economically according to the character of ore it has to work upon, the ore or rock having been previously tested.

To dissect a stamp mill into its essential and important parts I will take those composed of iron and steel.

As steel advances into the field of construction, the engineer naturally asks "what am I to do with it"? Can it be worked safely, is it reliable? Shall I use high steel or low steel? Facts are systematized and theories formulated by scientific men, but the practical men supply the facts. Miners are usually the practical men, the pioneers of civilization and progress in a mining country.

Iron and steel enter very largely into all kinds of mining machinery, but not all kinds of iron and steel can be advantageously employed in their manufacture.

Without going into the detail of their manufacture I would say that from the ore we have pig iron for the foundry or rolling mill. Its chemical relation to one of the metallic elements, carbon, are such that the addition of a small quantity of this element converts iron into steel, far surpassing iron in the valuable properties of hardness and elasticity, whereas a larger quantity of carbon gives rise to cast iron, the greater fusibility of which permits it to be molded into shapes which could not be produced by forging.

Five elements enter into pig iron in greater or less degree—carbon, silicon, phosphorus, manganese, sulphur; the same with steel but in rearranged condition.

Cast iron, when poured into iron molds, hardens just as steel does when quenched in water; this is known as "chilling." A chill is of silvery white color, bright lustre, and consists of elongated crystals generally normal lengthwise to the surface of the mold.

If iron contains little or no silicon, it will chill very deep or entirely through the mass in small castings. Silicon is as yet present in steel only by sufferance, and generally it is well known that steel is better without any of it. Steel is mainly an alloy, compound or mixture of iron and carbon.

Which of these it may be, it is difficult to say whether it is a combination of two or of all three of these conditions. The iron used in making steel determines its quality.

Crucible cast steel is recognized the world over as the best steel. Low priced steels prove to be very dear to the consumer.

Steel when heated and hammered from the ingot, has its specific gravity largely increased, its strength is also greatly increased and its grain is made very fine and uniform—this is called "hammer refining."

This hammer refining may be illustrated by comparing the hot steel to a certain solution of a salt. If the solution be allowed to precipitate slowly and undisturbed, very large crystals will be formed, but if it be violently shaken, the crystallization is hastened, and very fine crystals are formed.

Now dissecting the stamp mill into its principal parts we take up the *Shoes and Dies.* These have been in the past of cast iron or cast steel. Within very recent years a great improvement has been made in the manufacture of steel shoes and dies. Formerly owing to their tendency to chip and cup their introduction met with but little success. It was found by some mills advantageous to use cast steel shoes and iron dies, the iron dies wearing more evenly with cast steel shoes than cast steel dies did.

The majority of the mills in California, remote from foundries, where transportation is an important item in the cost, have replaced those of iron with steel. Cast iron furnishes more or less uneven wear, thus cutting down the crushing capacity, the dies wearing more or less convex and the cast steel concave. Cast iron also furnishes another feature, that of the great tendency to splitting and splintering off of the outside diameter of the die, presenting an irregular diameter of surface to that of the shoe, which also cuts down the capacity of crushing.

Shoes and dies are some of the most vital parts of a stamp mill —results depend upon it, and therefore cost of material for this purpose is a second thought.

Forged Crucible Steel Shoes and Dies are proving superior to those of cast iron or cast steel castings, owing to the belief that a more smooth and less rapid wear will result, and therefore greater crushing capacity per 24 hours. They have also the recommendation of requiring less change and time lost in adjusting the tappets, etc. Having gone through the process of hammering or forging into the required shape, the steel has become hardened to a very great extent, and is tough and dense. This quality of shoe and die is being extensively used in the mining sections of South Africa, where you may walk for miles without getting away from the sound of the stamps.

The matter as to the quality of material or stock from which these should be made became quite an important matter with the steel maker and one prominent concern made a series of experiments and trials to determine the question, which they finally solved and found that the steel when made from certain fine brands of Swedish iron and forged into shoes and dies proved superior, giving results impossible to obtain from iron or steel castings or other forged steels. The item of freight transportation to more or less inaccessible locations is a factor also in favor of steel over iron. Then again the natural wear is 2½ to 3 times that of white iron.

Some cast shoes and dies are called semi-steel. This is a misnomer, as the product is either iron or steel, although the mixture may be composed of both in certain proportions.

The shoes require to be tough so to lessen the tendency to break at the neck, should not cup, but wear evenly, smooth and true from beginning to end. Being forged are therefore sound, homogeneous and free from hard spots and blow holes.

The dies go through the same process of manufacture, but the stock from which they are made differs somewhat from that of the shoes, with view of securing a uniform wearing surface with the shoes. These are also tough, dense and hard, but not in the same degree.

Cams.—These should be of special steel castings, hard, tough and dense Tough so not to split when the keys are driven as in the case of ordinary iron and to withstand the sudden shock from contact with the tappets when the stamps accidently fall upon them.

In a properly constructed mill there is no shock to the cam when lifting the tappet. This is overcome with the cam designed from the actual distance between cam shaft centre and stem centre. It is to be regretted, however, that in many mills now in use and being built, the cam sustains an unnecessary shock ; this is due entirely to the negligence or ignorance on the part of the mill-wright.

These castings require to be hard and dense, to present a long smooth wearing to the surface. They should be properly bored and fitted to cam shaft with steel keys, duly marked as to position to give the required drop and machined on outside wearing surfaces, in order to lessen the friction in working against tappets, thus employing less motive power.

Tappets.—Should be of hard, tough and dense steel castings. Tough so as to avoid splitting when keyed. They require to be properly bored and fitted to the stem, machined on the two end surfaces which come in contact with the cam, to lessen the friction as much as possible in working against the cam. Being hard and dense they wear smooth and uniform. Ordinary iron or steel castings are not liable to do this and also have tendency to split.

The cams and tappets being properly fitted to the shaft and stem, and with the smooth machine contact surfaces offer less resistance and require less motive power.

Boss Heads.—These should also be of steel castings bored out for the stem and recessed for the neck of shoe and of great toughness as the neck of shoe is wedged in place by strips of wood which swell from constant contact with water and hold the shoes in place. In dry crushing pieces of iron are used.

Stamp Stems which are about 3½ inches diameter, 12 to 14 feet long, should be made of special crucible cast steel of high grade, with both ends tapered to fit the head, to be reversed in case of breaking. The stem receives the shock from the blows or drop of the shoe, in some mills as high as 105 per minute, but usually about 90, and therefore requires to be of a high grade of steel. In many plants ordinary wrought iron or cold rolled steel is used, but I believe the above will be found to wear the longer.

The first cost is greater however and so manufacturers put in the cheaper.

Reading a report in regard to the life of stems in stamp mills, I find the average (covering five years) was about 46 weeks and it stated that the stems generally broke square across the fibre (iron has fibre but steel has not) just above the upper part of head and sometimes below this or in the head. The best of wrought iron made into bands, for an old fashioned trip hammer, have broken apart in two days running from crystallization. Iron is very susceptible to this even if it is fibrous. The fracture in this case showing no flaw or cold short.

Cam Shaft may be of cold rolled steel, key seated for pulley and cams. It has not the same character of work as the stem and is housed or boxed in three places in 10 stamp mill. Some manufacturers use wrought iron turned.

Cam Shaft Boxes.—In most mills these are of cast iron, babbited and bored, planed on back. There have been mills built with these boxes of soft graphitic iron (silicon iron) smoothly bored and properly fitted to shaft without being babbited. This style of box requires more care to make and fit for the mill-wright, but is very advantageous for the mill man, using less oil and avoiding the trouble of rebabbiting, also running no risk of getting babbit into the mortar by its breaking under the shock that the cam shaft sustains.

Jack Shaft may be of cold rolled steel or soft steel turned.

Jack Shaft Boxes should be of same stock as cam shaft boxes.

Pulley on cam shaft is usually built of wood on cast iron flanges, turned and fitted, bolted through flange. The wooden pulley sustains better the rapid successions of jars from the dropping of the stamps, whereas an iron pulley would soon break from weakness.

Mortars are usually of cast iron, tough, free from blow holes or cold short, and of special design in connection with each particular mill, and are planed on the bottom, and for screen frames bolt holes are drilled and arranged for front and back copper lining.

Breakers or Ore Crushers.—These are of various makes and designs with merit to each and all; some requiring extra power according to class of rock crushed. The stationary and moveable jaws of the Blake crusher should be made of special hard steel castings of a character to withstand the effects of the great breaking strain employed while crushing hard rock. The wear and tear on surface of these jaws is also an item to be considered; when made of proper material, will wear uniformly throughout their contact surfaces and be a source of economy in reference to the output of a mill per 24 hours. It frequently occurs that the stamp mill has to lie idle from breaking of one or both of these jaws until replaced; therefore extra jaws should be kept on hand, to avoid any delay caused by waiting until new ones are received.

Each stamp mill should keep a duplicate set on hand of the principal wearing parts in case of emergency.

While in the West I saw a shipment of a 10 stamp mill received at the mine. Evidently this was the first of any kind that the manufacturers had built. There was no evidence of machine work having been done on the castings and therefore in all probability no part had been properly fitted together before leaving the shop, and the shoes and dies had the appearance of rough forgings made in any ordinary blacksmith's shop. This showed lack of experience and knowledge of the requirements in this class of machinery, and furthermore that the machinery had not been built under the supervision of an experienced mining engineer. I presume the mill owners paid for the experience in this case.

Drill Steel.—The last but not least that I will say a few words about is, the bar steel used in both hand drilling and in steam or air drills. The common shape is the octagonal used in both methods of drilling, but within the past few years a special shape commonly called ribbed or cross-shape steel—(the shape being of a St. Andrew's Cross) has come into general favour in air drills. In some sections the whole drill is of this shape, but in South Africa and British Columbia, they use the octagon bar for the shank and weld on to the end a piece or length about 18 in. of this cross shape steel for the cutting part or bit. The advantage in using this style of bit is that the time consumed in sharpening or repairing worn drills is much less and the bit more advantageously worked upon by the smith and with less labor, resulting in that the drills are kept in better condition. There being sufficient stock of steel in the 4 ribs to spread out in each direction the size bit required for the different size holes, prevents the drill from binding in the hole even if used all one size. This shape comes in a series of sizes 1¼ to 2¼ so that the regular following bit comes in use as the depth of hole increases from the starter. In making drills from the octagon bar considerable work is done in upsetting the steel into shape so as to make the 4 cornered bit spread sufficiently for the size hole required to be dirilled This continues throughout until the drill is used up, whereas with the cross-shaped steel, after the labor of welding it to the shank has been done, the work of dressing is easily and quickly done.

A great deal is expected of steel furnished for rock and mining drills. With the ordinary consumer the matter of price is a first thought, as they all have the idea that "steel is steel" and therefore should be able to do any work required of it, over-looking the fact that there are steels and steels of all grades made and adapted for specific purposes.

The quality of the steel for drills is an important item in working a mine to produce desired results. It is the experience of the old gold miners and drillers that the best is none too good for the work, especially when working on hard rock and also when quite a distance from blacksmith shop, particularly in the case of prospectors. As a rule the better the quality the more cutting the steel will do, before having to be dressed over, unless "doctored" in the smith shop. Some smiths wish a soft working steel under the hammer on account of its easy working and less attention required to heating, whereas on the other hand tools that are made from the best quality of steel to be had require little more care and judgment in working ready for use, but when properly made and tempered produce results that more than pay for the extra time consumed. Cutting more rock within a given time therefore requires less re-sharpening as compared with bits made from steels that dull up rapidly and have to be taken out of machine frequently and replaced by new bits. In other words steel at 8 cents per lb. is dear compared to steel at 12 cents or more.

Crucible drill steel made from Swedish Iron for its base is cheaper in the end than steel made from sponge metal or dephosphorized converted O. H. or Bessmer Steel, requiring it to be "physiced" to bring it to the proper contents of carbon, etc., as it is quite possible to make a comparatively low priced steel which shall show precisely the same chemical analysis as the best cruicible cast steel; nevertheless it is found by practical experience to be inferior in quality. Steel for all cutting tools and drills requires to have "body," therefore the base or stock must be pure.

The Mispickel Gold Ores of Deloro, Ont.

By J. Walter Wells, School of Mining, Kingston, Ont.

Near the village of Deloro in Hastings Co., Ontario, there is found a belt of metamorphic rocks in which occur a series of gold-bearing veins. For the past two months I have been experimenting on gold ores from this district in the Mining Laboratory of the Kingston School of Mining, and the paper, which I have the honor of bringing before you this evening, contains a few of my results.

The country around Deloro consists of low, rounded hills, the most striking feature being a large irregular mass of granite, whose longer axis lies in a north and south direction, and which is known as the Huckleberry hills. Surrounding this granite mass and conforming to its general outline, there is a series of metamorphic rocks of the Hastings series, consisting of dolomitic schists, talcose schists and quartzites. The talcose schists are of the most interest, as in them are found veins carrying quartz, dolomite, mispickel and gold. The veins are parallel to one another, and have usually been considered to be bedded or segregated veins as they follow the strike of the schists. Most of them are found close to the contact of the granite with the schists. A similar occurrence is found in Barrie township, in the County of Frontenac. This is the Weber mine, which is found in rocks of the Hastings series, near the contact with the Grenville series. The veins at Deloro seem to be similar in character, and a description of the Gatling vein, which is now being worked, serves for all.

This vein has an average width of from seven to ten feet, and runs nearly due north and south with a dip of 30° west. It is composed of vitreous quartz, grey arsenical pyrites or mispickel, dolomite or "bitter spar" and in some places biotite is found. The mispickel is generally fine grained and compact, but large silver-white, striated crystals, prisms of the Rhombic system, are often found. Native gold is sometimes seen adhering to the faces of the crystals. Analysis of the mispickel made some years ago by Thomas Thomas and J. H. James, of Swansea, Wales, gave the following results:—

	Fine grained varieties.	Coarsely crystalline.
Peroxide of iron	54 00	56 00
Silica	0 57	0 03
Sulphur..	19 31	18 13
Arsenic........................	25 70	23 00
Nickel	trace	trace
Silver (per ton of 2,000 lbs.)...........	trace	$6 50
Gold " " "	$306 95	$2,920 67

The mispickel often contains a trace of cobalt, which may be detected by blow-pipe tests. I also found several perfect crystals of zircon imbedded in the dolomite and associated with the mispickel.

Assays of the ore recently made in the laboratory of the School of Mining gave the average gold contents as $30 per ton. For the sake of comparison, I append assays made by ex-Prof. Chapman of Toronto University. Sample No. 19, $38.65 per ton; sample No. E, $24.87 per ton; sample No. F, $36.60 per ton; sample No G, $24.74 per ton.

The gold bearing veins in the Hastings series are found in schistose rocks, chiefly talcose, and are generally parallel with the strike of the rocks. Hence they have been called bedded veins. It is doubtful, however, as pointed out by Phillips in his work on ore deposits, whether there is any difference in origin between many veins of this class which occur in highly metamorphosed rocks and those which are called "true fissure veins." Metamorphic rocks were considered by the older geologists to be derived from sedimentary material, and for this reason the schistosity was compared to bedding. Of late years, however, many of the most strongly schistose varieties have been proved to be altered igneous rocks. While many of the members of the Hastings series are undoubtedly of sedimentary origin, such as the metamorphic conglomerates and calcschists, there is as yet no proof that other members, such as the talc and mica schists, are not metamorpose igneous rocks. The schistosity in these latter may have been produced partly or wholly at the opening of the fissures, which were afterwards filled with the metalliferous matter and are now represented by the gold bearing veins. The schists in the immediate vicinity of many of these veins are cut through by dykes of different kinds, chiefly diorite and more basic rocks. And at the Deloro mine none of these dykes cut at one time across the rocks before the space which is now occupied by the gold bearing veins was formed. At the time of the formation of the fissure this dyke was broken across and pulled apart, thus giving the ore deposit. It seems to me the character of a true fissure vein just as much as if it cut through a large mass of igneous rock or across the strike of the schists. During my visit to the mine in the latter part of December, I obtained specimens of this dyke which, I believe, has not been referred to by other writers on the district, and I have since made a microscopic examination of sections of the rock. Specimens were obtained in a cross-cut on the lower level of the main shaft, and on the hanging wall some distance from the side of the vein and from a "horse" near the foot wall of the first level. On microscopic examinatiom both specimens were found to belong to the same rock. Although the material of the horse being nearer the edge of the vein, was much metamorphosed. The thin sections from the specimen on the lower level showed the rock to consist of plogioclase, orthoclase, biotite and some quartz together with uther minerals in less quantity. The section from the horse showed it to contain orthoclase, flagioclase, a little brotite, muscovite and talc. The two specimens resemble each other very closely in the proportion of acid and basic minerals, with the exception that most of the black mica and some of the feldspar of that from the lower level is represented by their metamorphic equivalents, muscovite and talc in the horse. Thin sections were examined from other dark colored dykes in the vicinity of the vein. They are similar to those described.

The condition of gold in the mispickel seems to be a debatable point. Some of the gold undoubtedly occurs free, as may be seen by panning and in certain specimens showing native gold. But it is the invisible gold which causes the discussion. This is either chemically combined or in a mechanically fine state of division. Ex-Professor Chapman of Toronto University believed the gold to exist as an arsenide, but his reasons have not been published as far as I know. I made a series of experiments to ascertain the real state of gold in the mispickel and the results, though not settling the question by any means, throw light on a few points. The experiments in favor of the "combined" theory are as follows:

(1.) Mispickel rich in gold was crushed to 70 mesh and treated in a hand arrasta. The mercury refused to extract the assay value of gold.

(2.) A gold button was treated with hydrogen sulphide for nine days. A brown coating was formed on the button, which refused to amalgamate, showing that a coating of sulphide of gold had been formed.

(3.) Gold foil was fused with mispickel in absence of air. A dark grey powder formed around the button, which became brittle and refused to amalgamate due to formation of arsenide or sulph-arsenide of gold.

(4.) Gold foil was fused with arsenic trisulphide, a brownish-red powder formed, button became brittle and refused to amalgamate.

(5.) Mispickel known to be rich in gold was examined in thin sections, with highest powers of the microscope. No trace of gold was seen.

(6.) Gold was digested with strong solution of caustic potash and found to be insoluble. Trisulphide of gold (An_2, S_3,) was digested with solution of caustic potash and found to be soluble. I also digested mispickel with solution of caustic potash, reasoning that if I got gold in the potash solution the gold must be in a combined state as a sulphide. I obtained a black precipitate from the acidified solution by hyd. sulphide which was proved not to contain iron, copper. I also failed to get good tests for gold by stannous chloride, ferrous sulphate or blotting paper tests. This, however, may be due to the small amount of precipitate obtained.

The reasons in favor of the "free" theory are as follows:

(1.) The gold may be in the allotrophic form which is known to resist the action of mercury.

(2.) Failure to amalgamate may be due to a coating of sulphides around the gold arising from decomposition of pyrites.

(3.) The particles of gold may be so embedded in the pyrites that only chemical means will free the gold.

(4.) The particles of gold may be invisibly fine so that the highest powers of microscope cannot detect them.

It is commonly stated in text books that if gold exists in a combined state in an ore, it is dissolved out by treatment with nitric acid. This I found to be an erroneous statement with regard to arsenide of gold and the ordinary sulphides. The arsenide is decomposed by nitric acid, giving free gold and forming arsenic acid ($H_3 As o_4$). The sulphides are not attacked by nitric acid. I digested pulverized mispickel with nitric acid and found no trace of gold in the solution. The residue on the filter paper was tested for gold and gave excellent purple colors in the blotting paper tests and also good result with stannous chloride.

Gold was first discovered in the Marmora district in 1865 and numerous attempts have since been made to extract the precious metal. The first attempt consisted of treating the ore by raw amalgation in primitive stamp mills. The ore became refractory when the water-line was reached in the shafts and failure ensued.

A few years later the Canada Consolidated Co. commenced operations, and a large mill was constructed to treat the roasted ore by the barrel chlorination process. The ore proved refractory even by this process and the works were shut down. In connection with this, it will be interesting to know that the modern chlorination plant in our Mining Laboratory was successful on two different occasions in extracting gold from mispickel. Over 90 per cent. of the assay value was extracted in each case.

The next scheme was tried by the Hastings Mining and Reduction Co. in 1892. They proposed to treat the pulverized and roasted ore with mercury vapor, condensing and passing over copper and silver plates to catch the amalgam. The process, experimentally successful, proved to have too many working parts and work was soon stopped.

And now a new process has entered the lists against the hitherto victorious mispickel.

This process, known as the Bromo-Cyanide, was invented by Mr. Sulman, and has been successful in Australia. It seems in many respects to be a combination of the cyanide and chlorination processes. The solvent used consists of the ordinary cyanide with a small proportion of one of the haloid compounds of cyanogen, viz: Chloride, iodide or bromide. The bromide is mostly used as it is cheap and portable.

The solvent is claimed to be particularly successful in extracting gold from refractory ores, such as arsenical, antimonial, manganiforous and copper compounds. The ordinary cyanide fails to extract gold satisfactorily from such ores. According to Mr. Sulman, this is due to: (1.) The oxidization of iron and other base sulphides with consequent destruction of the cyanide; (2.) the production of caustic potash as a necessary reaction product of the solution of gold. These defects are got rid of by adding haloids which cause no hydrolysis and take up the potassium set free. The chemical reaction is expressed thus:

$Cy\ Cl\ x\ 3\ K\ Cy\ x\ Au_2 = 2\ (K\ Au\ Cy_2)\ x\ K\ Cl.$

This equation also shows that the solvent power is not due to liberation of oxygen from decomposion of water by free chlorine since the stable chloride of cyanogen is used.

Comprising this reaction with that of the cyanide process, viz:

$4\ K\ Cy\ x\ Au_2\ x\ H_2\ O\ x\ O = 2\ (K\ Au\ Cy_2)\ x\ 2\ K\ O\ H$, it may be seen that the fatal defect (necessity of a good supply of oxygen) is entirely obviated.

This solvent was tried on refractory ores of all kinds by the inventor and other chemists, with surprising success. He claims the solvent is over 100 times more rapid on free gold than the cyanide, and he ascribes the results to:

(1.) The enormously accelerated solution of the gold, wherever its particles are easy accessible, by having potential cyanogen always ready at hand to effect the formation of aurous cyanide necessary for the soluble double salt of gold and potassium.

(2.) The avoidance of production of caustic potash, the product being quite inert as regards the further formation of cyanide destroying compounds.

To illustrate this rapidity of solution, I quote an experiment made by the inventor :

" A shaking test upon a sample of Canadian arsenical pyrites was made with 0.3 per cent. K Cy and 0.3 per cent. K Cy x 0.12 per cent. Br Cy. Half an hour's agitation of the ore (which originally assayed 7 dwt. of gold), yielded, with cyanide alone, tailings assaying 3 dwt. 22 grains, and with our solvent, 1 dwt. 20 grains of gold, or extractions of 44 per cent. and 74 per cent. respectively." The plant required is about the same as used in the ordinary cyanide process. A dilute solution of potassium cyanide is used and to the contents of the storage tank, and addition of the bromide of cyanogen is made in proportion 2 of potassium cyanide to 1 of bromide of cyanogen. The ore is crushed dry to about 70 mesh fineness, treated in leaching vats with the solution from the storage tank for a few hours till the gold is all extracted. The solution is then filtered off and the gold precipitated by zinc fume, *i.e.* finely divided zinc purified by the ordinary means.

The Canadian Gold Fields Ltd., is now erecting a large plant consisting of a mill for the crushers, rollers, and leading tanks, assay and chemical laboratory, shaft houses etc., for the purpose of testing the efficiency of the solvent on a large scale.

It is to be hoped the venture will prove successful, as the Hastings district is rich in auriferous mispickel veins.

The Utilization of the Mill Refuse and Peat Mosses of the Ottawa.

By E. A. SJOSTEDT, M.E., Bridgeville, N.S.

Having been requested by your secretary to present some facts at this meeting, it occurred to me that certain features of the fuel question—itself of vital importance to every industry in the land—would possess special interest to some of the members of the Institute engaged in the development of the industries of the Ottawa district, which, lacking in mineral fuel, in its stead possesses a mine of wealth in the enormous amount of mill refuse now going to waste, and in its large but dormant peat bogs, which by proper care and judicious adaptation could be made to yield a handsome profit.

To prove this assertion it is but necessary to direct your attention to the means adopted in some of the countries of great industrial importance where mineral fuel is scarce or altogether lacking, among which Sweden, Germany and Holland stand out most conspicuously. The first mentioned country is in fact the very home of such adaptation of wood, mill refuse and peat for metallurgical purposes, and the utilization of peat for fuel in Germany, Holland, Denmark and other European countries is of the greatest importance, if not the very possibility for many of their industries. With them necessity has been the mother of invention, "but as they have marked the way shall not we follow whenever true business policy would dictate?"

The history of the European peat industry is a checkered one, as shown by a recent article by Prof. Klason in Teknisk Tidskrift. According to this authority the modern peat enterprises began after the Napoleonic wars, when a general revival in all branches of business was experienced, and a special need felt for cheap fuel, light, iron and paper. The railways were then, also, in their infancy, and no knowledge was had of the great quantities of mineral fuel which the earth possesses. Besides, the price of coal was then about double to what it is at present, owing principally to the high cost of transportation. It was, therefore, most natural that the attention was early directed toward the peat mosses, which long had been known to supply fuel for the inhabitants about the moors, and from which now it was expected to receive both heat and light. Ireland, with its enormous bogs, and England, the centre of industry, were among the first to take up the peat problem, and in 1849 the Irish Peat Working Co. was formed with a capital of £500,000. Their idea was to make a concentrated fuel equal to that of coal, by compression and partial carbonization. Two other companies were also formed with a total capital of £620,000 for the dry distillation of peat and the utilization of the by-products; and their exhibit on a large scale at the London Exhibition in 1851 created much comment. But in 1853 not a peat plant was in operation. The experimental stage of the peat industry in many of the other European countries was equally disastrous, as, for instance, in Bavaria, where the government expended hundreds of

Pressing and Drying Heat.

thousands of florins in aid of the peat industry, and in Sweden, where many different methods were tried in succession before the peat came to be recognized as a source of wealth. And from the catalogue of the minerals sent to the Colonial Exhibition in 1886, we find that the same discouraging results were met with here by the Canadian Peat Fuel Co. in their attempts in 1875 at St. Hubert and St. Brigide to manufacture peat fuel for domestic purposes, and for the G. T. R. Co. in their locomotives.

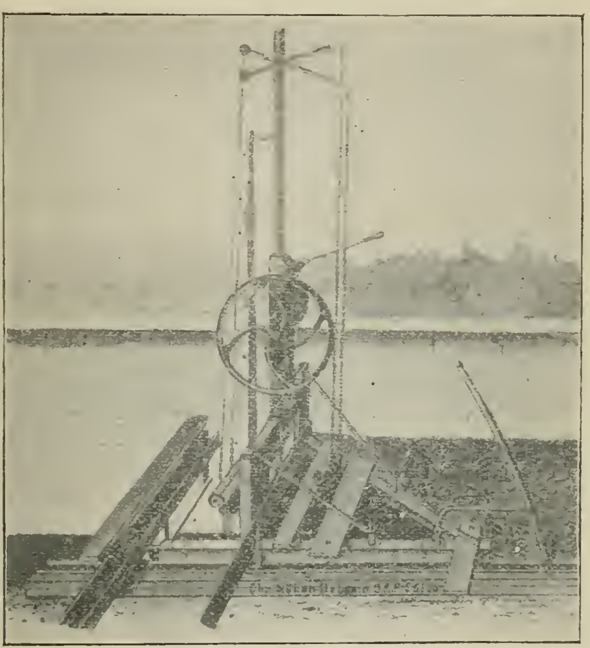
After much careful investigation and persistent experimenting this industry has now, however, been brought on a paying basis and become of national importance in many parts of Europe where mineral fuel has not been found.

Possibly it is in Holland that the peat mosses are at present most extensively worked, and of the results there obtained we can get an idea by quoting from a late number of a Danish agricultural report:

"The peat industry in Holland is of a very great magnitude and ranges first among the economic questions of the land—several milliards of gulden having been here saved by its use as fuel. As an instance only may be mentioned, that the Rahder Co. of Nineweroord has eight steam machines in operation, which daily produce 200,000 peat bricks, selling at the bog for 3.70 gulden per thousand. At a minimum of one hundred working days, this means an annual production of 20 million bricks, which are obtained from about seven acres of peat bog, and represent a value of 74,000 gulden (or nearly $30,000) for this mill alone. And it is estimated that Holland has recovered the peat from 300,000 to 400,000 acres of bog, or a value about $1,400,000,000."

Denmark, also, leads in the peat industry, and the model works at Sparkjaers produce annually 15,000 tons of peat for local consumption alone, making a profit of about 90 cents per ton.

And from Germany we read in the Consular report to the United States (see Caissier's Magazine, June, 1896), that "peat, or turf, is used throughout Europe generally whenever the ordinary cost of its production is not materially increased by cost of transportation. In the large and small cities, as well as in the country districts, it is used for fuel—in fact in many localities it is the only substance used for heating purposes. It is used, likewise, in industrial establishments; but its use in locomotives had to be discontinued in order to prevent danger of forest and field conflagrations. Besides its use as fuel, peat is turned into account in Germany as a fertilizer and as building material, it being successfully used as a filler for vacant spaces, separating layers for waterworks, reservoirs, ice houses, etc. By means of a process patented by a tanner in Mayenne, it has also been made to do service in tanneries."



A Peat Cutting Machine.

Having thus seen that this despised and neglected substance is receiving due recognition elsewhere, it may not be amiss to tarry a while and consider its nature and technics.

Peat is the product of spontaneous decay of vegetable matter, more especially of marsh plants, mixed with various mineral matter—

an "unmineralized coal," as it has been named—which covers vast parts of the earth's surface within the temperate zone. (In Ireland 2,830,000 acres, or nearly one-seventh part of the entire area of the island is estimated to be covered by peat bogs, and in Sweden we have about 10,000,000 of acres of bogs, and in Germany about 5 per cent. of its surface is covered by peat bogs.) The different qualities of peat are chiefly due to the more or less complete decomposition the plants have undergone, the mineral substance mixed with it, and the degree of compression to which it has been subjected. The least decayed kind is called "moor-peat," and from it *moss peat litter* is manufactured. The peat of a more advanced state of decomposition is known as "*fuel-peat*" and is of a dark, compact character. This kind of peat, again, receives different names according to the different methods by which it is manufactured into a commercial product, as cut-peat ("Skartorf"), moulded peat (alt-torf), machine ("tube" or "ball") peat, and peat coal.

The peat or moss litter was first made on a large scale in Hanover (in 1879), and since then it has been gaining steadily in demand, owing to its many useful qualities. As a bedding for domestic animals, it is soft, elastic, dry and absorbent. By reason of its latter characteristic it thus becomes a valuable fertilizer, as well as a disinfectant (absorbing the malodorous gases, especially ammonia, formed by the decomposition of the manure—a quality not possessed by the straw-litter.) Saturated with the waste-liquids from the sugar refineries, it leaves a highly prized fertilizer for grain and sugar beets, and as a packing for fruit and fish, it has proved to keep these perishable goods in good condition during a long time and under transit. It has also been made to do duty in the fishery department, it being pronounced a most suitable substance in which to pack and ship spawn. Owing to its hydroscopic qualities (absorbing six or eight times its weight of water) it can also be used for drying out damp rooms, is used in the manufacture of porous brick, as filling material of mattrasses in hospitals and for children, for storing ice (being a poor heat-conductor, on account of its porosity), for filtering oils, etc.

Fig 5

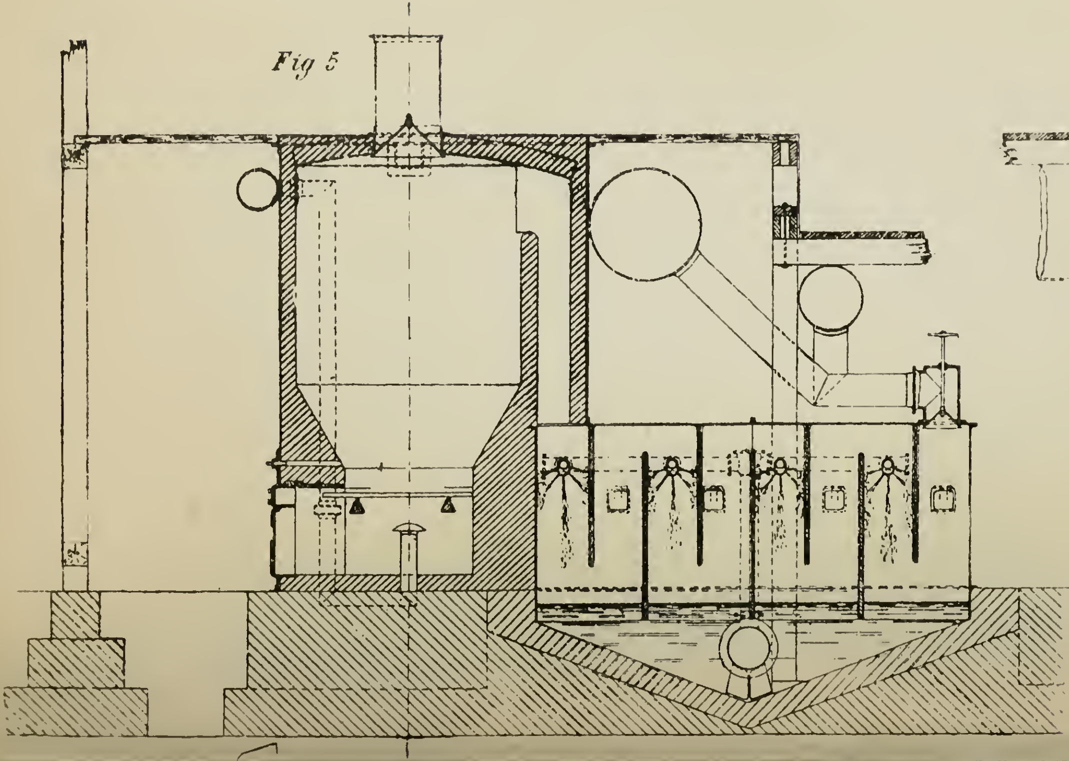


Fig. 6

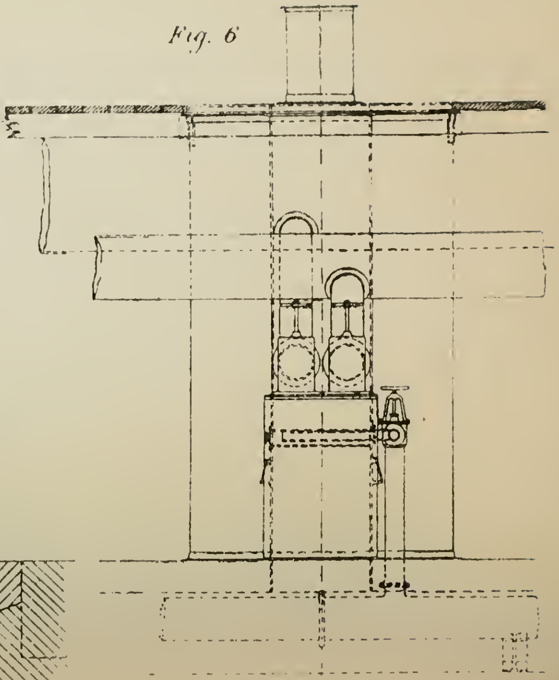


Fig 7.

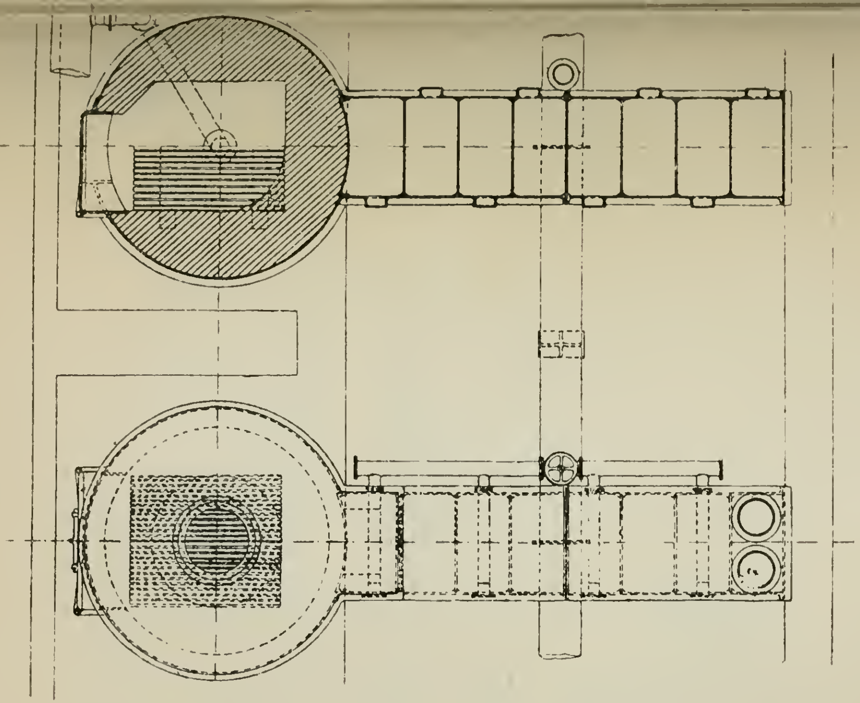
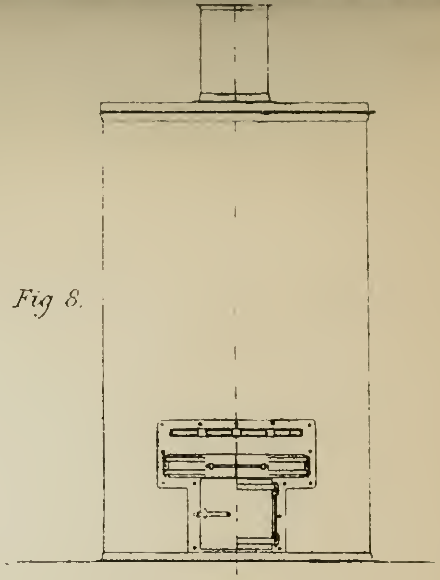


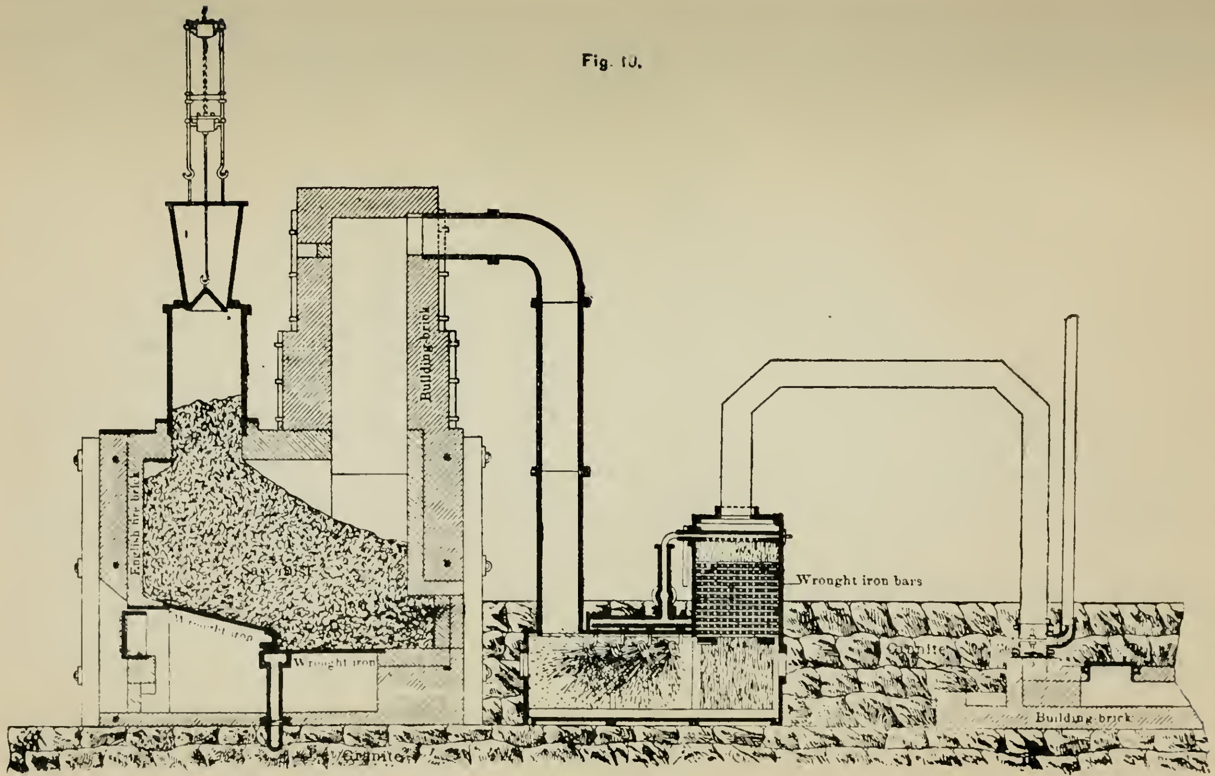
Fig 8.



LUNDIN'S GAS PRODUCER FOR WOOD.

(Illustrating Paper by Mr. E. A. Sjöstedt, on "The Utilization of Mill Refuse and Peat Mosses of the Ottawa District.")

Fig. 10.



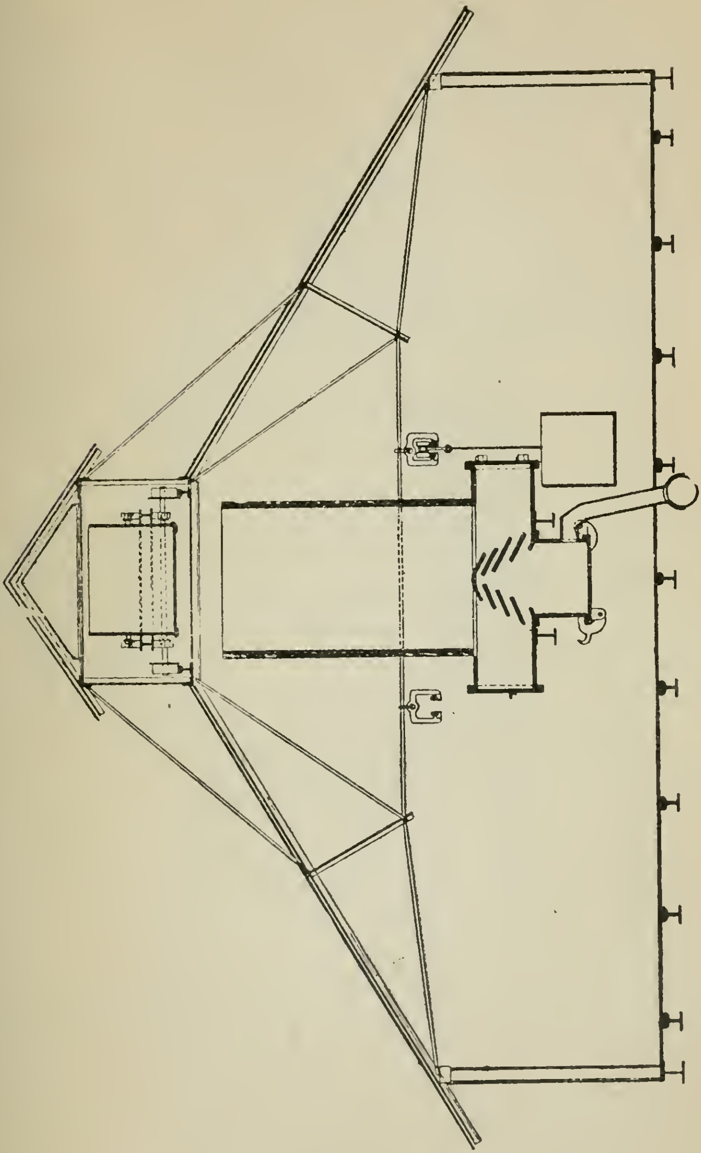
Lundin's Gas-Producer for Wood. Scale 1:75. (Pipes and plates in black are cast-iron, except where otherwise specified.)

Peat fibres have long been used for texture manufacture. Thus in Holland, England and Ireland, it is made into mats, blankets and even finer goods for wearing apparel; and in France and Russia it is made into cloth for bandages and other surgical purposes, owing to its antiseptic properties (peat retarding the development and increase of microbes.) During the last few years it has also been much spoken of in connection with Ekelund's method of manufacturing peat-dust, by which operation it is obtained as a by-product. After drying and crushing the peat, namely, the fine particles are separated from the coarser fibres, which latter are subjected to a washing process, and freed from adhering peat dust. In this state they are ready for use as a yarn, or are compressed into bales for export, obtaining a ready sale in England at about $25 per ton. The peat fibres can be bleached quite white, but are also used in the unbleached state.

Peat as a fibre for paper manufacture is also receiving attention in England. And some years ago a method was developed in New York City, for the making of kindling, by immersing the dried peat blocks (which first have been sawed into small bricks of 1 in. x 5 in.) in raw petroleum, when they absorb from 15 to 20 per cent. of weight, and then coating them with rosin, in order to prevent evaporation.

The manufacture of artificial wood from peat is the subject of a German patent (Tekn-Tidsk, Nov., 1896). After the peat has been thoroughly washed and broken up to fibres and peat dust, it is agitated into a pulp, which is dried and then mixed with plaster-Paris water, to which is added a little lime. This mixture is thereupon put into moulds and subjected to a strong hydraulic pressure, until most of the water is eliminated, after which it is kiln-dried and coated with oil, or a solution of rosin and alcohol. This artificial wood is said to be very durable, and to well resist the influence of heat, cold and pressure, and can be worked in the same manner as common wood.

The value of peat as a fuel, naturally, depends on its caloric effect and its cost of manufacture. To ascertain its heat value, most thorough tests were made a few years ago by Prof. Klasson, one of a committee appointed by the Swedish government to investigate the merits of peat coal made by Mrs. Angel's and Lieutenant Ekelund's methods, and



Kiln for Drying Wood.

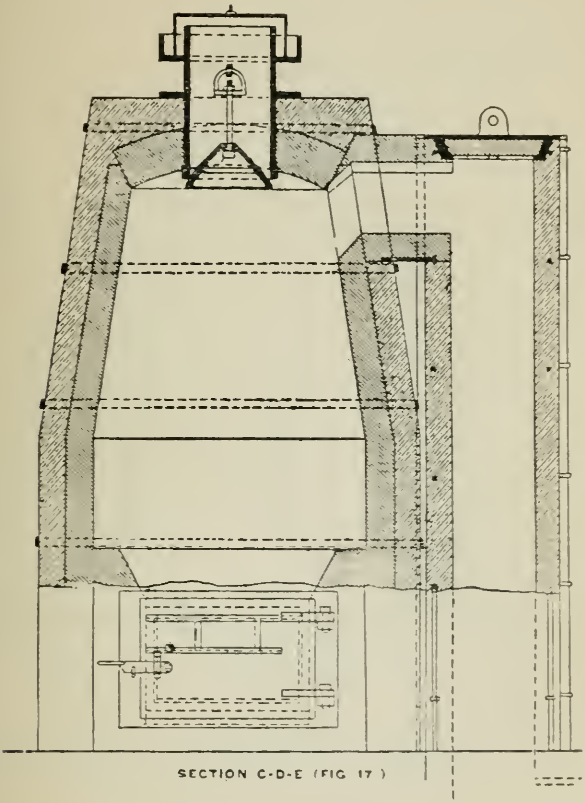
the results obtained are embodied in an exhaustive article in the jubilee number for 1896 of Teknisk Tidskrift, from which the following table is taken, showing the average composition of the organic substance in different kinds of fuels, together with the mean calorics of the absolute dry and ash-free fuel, and the average percentage of moisture in its dried state. With caloric is here understood the metric centre caloric, or the amount of heat required to raise the temperature of one kilogramme water at 0° C to 100° C (or 2,204 lbs. avoirdupois from 32° F to 212° F).

	Wood	Peat.	Brown Coal.	Swedish Coal	English Steam Coal.	English Gas Coal.	English Cooking Coal.	Welsh Anthracite.
Carbon	52.0	58.0	66.0	78.0	81.0	87.0	89.0	91.0
Hydrogen	6.2	5.7	4.6	5.1	5.2	5.2	4.9	3.5
Oxygen	41.7	35.0	28.0	14.8	11.5	5.5	4.1	3.5
Sulphur	.....	.....	.....	.8	1.0	1.0	1.0	1.0
Nitrogen	.1	1.2	1.0	1.3	1.3	1.3	1.0	1.0
Calorics	49	57	60	75	80	87	86	86
‘Hygroscopicity’’ p c	20	22	25	13.5	7.6	1.7	1.4	2.0

From the several individual tests made it is shown that the composition of each special kind of fuel is nearly constant, consequently the heat-values differ but slightly from the average value of the corresponding class; and in order to determine each individual fuel's caloric value, it is therefore sufficient, for all practical purposes, to determine to which class it belongs, its percentage of moisture and ash. The calorics of the organic substance, multiplied by the percentage of organic substance it contains, less the amount of heat required to evaporate the water present, as well as that formed by the combustion of the hydrogen present gives the heat value of the fuel in question.

The great importance of a *dry* fuel is here at once made evident.

In the report of the above mentioned committee, the average cost of manufacturing the different kinds of fuel peat in Sweden is stated to be as follows:



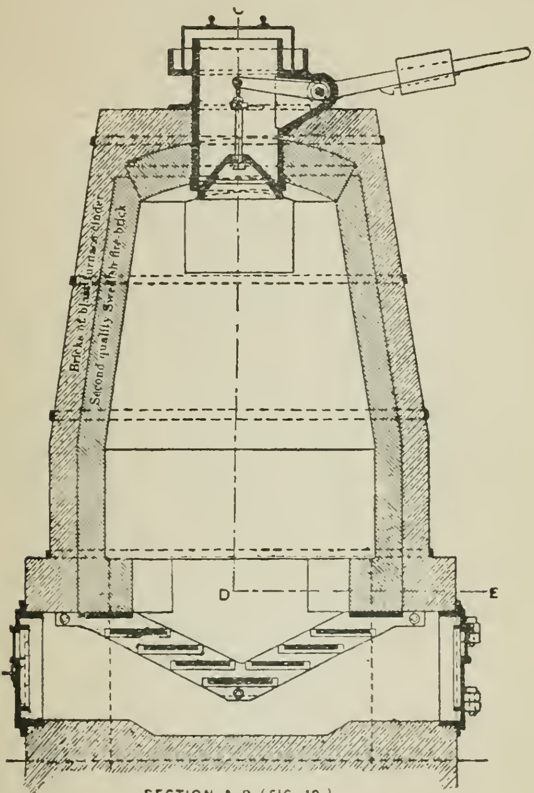
SECTION C-D-E (FIG 17)

Cut peat........	$1.05 per short ton	and	$1.70	Including interest and depreciation of plant.
Moulded peat.	1.16 “	“	1.82	
Tube peat	1.60 “	“	2.19	
Machine peat.	1.86 “	“	2.45	

These prices are for peat principally recovered by manual labor; but recently ingenious machines have been invented for cutting and taking up the peat from the bog, besides which many improved methods have lately been adopted, which have materially reduced the cost of manufacturing, and in the July 1896 number of Teknisk Tidskrift the average cost price for Sweden is stated to be 55 cents and 60 cents respectively for cut peat, and $1.01 and $1.14 respectively for machine peat, with an average of 20 per cent. of water. And at Sparkjaer works in Denmark the very best machine peat, weighing 28 lbs. per cubic foot, is there manufactured for 36 cents per ton, or when interest and depreciation of plant are added, and the price of the bog estimated at $155 per acre, for 71 cents per ton. The wages here range between 82 cents and $1.10 per working day. In Wurtemberg the cost of cutting, drying and storing, by combined manual and machine work is 94 cents per ton.

The conclusions arrived at by the committee, as well as by Prof. Klasson, in regard to the peat-briquettes, peat-coal and the peat-dust, were that they are all good and satisfactory fuels, but that the peat-coal, of which so much had been said and written, and so many great advantages expected, is not, economically, what it was claimed to be, 16 per cent. of the heat value of the peat being lost in the process of distillation (carbonization). Peat in the form of a highly dried powder, on the other hand, has lately been recommended as an easily transportable, cheap and effective fuel, especially when used in connection with some of the late devices for continuous firing, with or without the application of blast.

Peat as a fuel for air furnaces, as well as for domestic purposes and for steam generating thus has gained in favor at the same rate as its suitability and cheapness has been recognized; but it is as raw material for generator gas where it, to my mind, has its greatest possibilities. In this connection we will now consider it together with the other wet fuels—the sawdust and other mill refuse. The employment of gaseous combustibles has long been known, and its use was greatly extended with the successful application of the regenerative principle by Siemen. But it was not until Lundin invented his condenser that wet fuel could be utilized in this manner. The manufacture of fuel-gas from carbonized fuel (charcoal or coke), namely, is very simple. Air is forced through the mass of hot coal in the generator, and when this air meets the coal, carbonic acid is formed, which gas is reduced to combustible carbonic oxide during its further passage through the glowing coals. But when peat, wood, sawdust or similar fuel is used, the process becomes a more complicated one. The carbonization of these materials must first take place in the generator, besides which all the water they contain (varying from 20 per cent. to 50 per cent.) must be evaporated. But as the steam thus generated would dilute the gas


C
Bricks of blast furnace cinder
Second quality Swedish fire-brick
D
E

SECTION A-B (FIG. 19.)

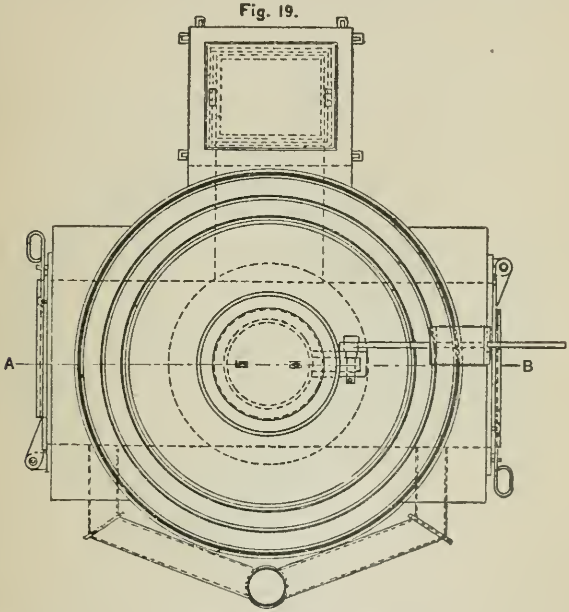
too much and cause a great heat-reduction in the gas-furnace, it becomes necessary to condense the steam, and this is now accomplished by placing a so-called condenser between the generator and the combustion chamber. Of these there are two types, the Lindin's and the surface condenser. In the first mentioned one the gas first passes into a chamber in which small streams of cold water are discharged, crossing each other in various directions. It then goes through a second chamber filled with wrought iron bars, arranged in cross layers, and kept cold by a stream of water trickling over them, and condensing nearly all of the remaining vapor.

Another arrangement, on the same "direct-condensation" principle, is where " the gas produced passes downward by a rectangular iron box, divided internally by partitions reaching nearly to the roof and floor, alternately, into a series of cells, through which the gas is made to travel in a zig-zag direction, and encounters at the top of each alternative division a series of jets of water, which cool it and remove the steam and other condensable substances with which it may be mingled, and deliver it in a dried state to the main flue."

But as the condensed tar gives to the water a strong smell and taste of creosote, and the water consumption is considerable, the fish were found to die in the streams in which the condenser water was discharged, and in order to remedy this evil Bjorklund constructed his surface condenser, " consisting of brass tubes, surrounded by cold water, through which tubes the gas was forced to pass. These tubes being difficult to keep clean, Wiman designed as a substitute, thin sheet-iron boxes, placed near together, into which the cooling water is admitted at the bottom to pass out at the top, while the gas passes between the boxes from the top downwards. This method makes it practicable to separate independently the water, tar and acetic acid from the gas, and permits the transportation of the noxious substances by rail to places far from the river."

It is true that a considerable quantity of heat is lost by this cooling of the gas, as well as by condensation of some combustible hydrocarbons, but, nevertheless, it has proved advantageous and more economical than to use the fuel direct, as the combustion of the gas is more complete and accomplished with less excess of air, the gas-fuel easier applied where needed, and because an inferior material can be used in the generator. Besides, the generator-tar is now saved in many places and mixed together with charcoal braise or sawdust, this mixture passes through a peat-machine, and the tar-fuel is dried and used for steam generating. From results obtained in practice at Fogersta Iron Works, Sweden, it has been proved that one cubic metre of this fuel corresponds in heat value to 0.76 cubic metre best South Yorkshire coal.

Fig. 19.



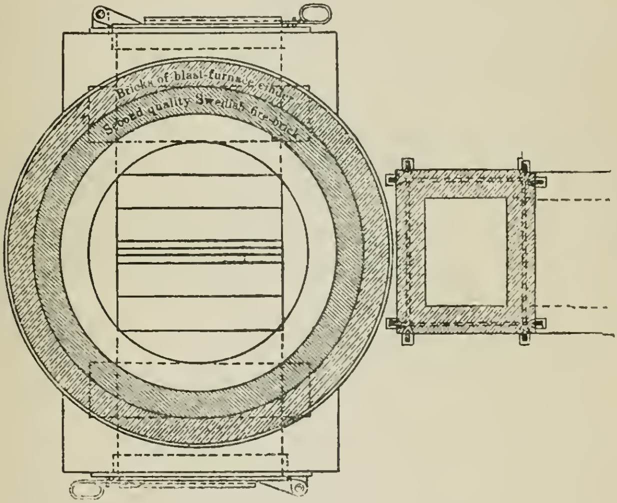
Gas-Producer for Dry Peat and Mill Refuse, Wood or Coal. Scale 1:40.

Another way of avoiding the loss of heat in consequence of condensation is to first *dry* the peat and the mill refuse, and to generate gas from the same on the Ekman principal. This drying is accomplished in specially designed ovens, which at Degerfors Iron Works, for instance, consist of vertical sheet iron cylinders in which the wet fuel is placed, and through which is forced air that has been heated to about 90°C by the waste heat from the Lancashire forges. And for drying wet fuel on a larger scale the so-called Kidd-Barff "half-coaling" process has in Austria received extensive recognition at such works where peat, slabs and all refuse from saw-mills, and trimmings from the forest trees, are used as fuel. Here the drying takes place in batteries of brick ovens, each system consisting of four rooms, in which the fuel is placed on railway trucks, and dried from a separate boiler by superheated steam and the combustibles passing through these chambers on their way out to the chimney, the temperature reaching 300°C.

The advantages of such a drying has lately been emphasized by a Swedish metallurgist, Odelstjenna, who writes that "he has had occasion to observe that tar condensed out of water containing fuel gives more heat, if it be allowed to pass into the furnace and be consumed there than the equivalent of the heat which the water vapors in the fuel carry from well constructed modern furnaces with large regenerators; and in accordance with this observation experiments were carried out with both green and dry wood; and refuse from saw mills for firing the open hearth furnace. These experiments led to the construction of a special producer type with drying apparatus, by means of which such a considerable saving in the wood is made that it now becomes much cheaper to fire with wood than with coal. As the producer is not larger than one of the commonly used coal gas producers, it can be run with coal as well. The apparatus for drying the wood consists of steel plate cylinders, covered on the outside with asbestos board, and this again is protected by a thin cover of wood. A certain amount of dry wood is taken out at a time, while the same amount of fresh wood is put in, so that the apparatus works continuously. The drying current is furnished by the products of combustion escaping from the air-regenerators of the open hearth furnace. These, instead of passing to a chimney, are drawn by a suction fan out and up through the drying cylinders. And in order to prevent setting the fuel on fire, an automatic heat-regulator is provided by inserting in the blast pipe a copper wire, which, expanding as the temperature of the drying current is raised, opens a valve, when at 120°C, which admits cold air.

We have now briefly shown how peat and mill refuse is being utilized in Europe, and especially how in Sweden nothing of a combustible nature is allowed to be wasted, but is gathered into store houses and used as fuel for various metallurgical operations. The example thus set I would now most earnestly recommend to the consideration of the owners of mills and peat bogs of the Ottawa as well deserving of their attention. The idle peat mosses, namely, could here be utilized in the several ways now mentioned, and the troublesome mill refuse be turned into a profitable material, especially in their employment as gaseous fuel for various metallurgical operations, in steam generating in the ceramic art and brick making, in the glass industry, for burning limestone, and calcining sulphurous and refractory ores, etc.

Fig. 20.



Gas-Producer for Dry Peat and Mill Refuse, Wood or Coal. Scale 1:40.

There are many, I know, who consider the fuel gas inferior in heat intensity to that of coal or other solid fuel, owing to the lack of solid incandescent matter in the gas flame. But this is true only when a substitute for the incandescent matter is not introduced in the form of fire brick walls, or combustion chambers, to do the duty of the solid fuel. With properly constructed boilers and furnaces, however, where a complete combustion of the gas is possible, the gas possesses many advantages over the solid fuel.

In conclusion, I may add that the gas producer lately has found a wide promising field in producing gas for use in gas engines.* These have, until recently, been of small power, and the tendency has been to look upon them as substitutes for the steam engine under particular circumstances only. But the gas engine has latterly reached a stage of development which now warrants its assumption of the title of a large motor. It has been made of several hundred horse power, and in some instances has displaced the steam engine even for such purposes as driving flour mills and generators in numerous electric lighting stations. It has, in fact, proved itself sufficiently regular in speed for any purpose. This development of the gas engine has naturally reacted upon the gas producers, which are now neatly designed and cleanly in working, and equally applicable to bituminous and non-bituminous fuel, and can therefore be employed to utilize what has hitherto been considered " good-for-nothing rubbish."

And (to quote Dr. Sterry Hunt in his report on Lindin's gas generator and condenser) " when such results can be obtained with sawdust, or with ordinary peat, the want of mineral coal need no longer be an obstacle to the development of the metallurgical industry of this country."

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*Cassier's Magazine, April, 1895.

The Mechanics of Mining.

By D. W. Robb, M. E., Amherst.

The general public seem to regard mining much in the same light as a search for "Captain Kidd's Treasure," mysterious, difficult and uncertain; but, having discovered the mine, the fortune has only to be picked up. This belief is, perhaps, unfortunate, since it leads to the loss of money and faith, and tends to produce distrust of all mining ventures. Yet this gambling spirit, which seems inherent in humanity, the desire to acquire wealth with little labor, is perhaps not an unmixed evil, because, if all enterprise was limited to absolutely safe investment, very few mines would be discovered. The mining engineer knows only too well that, notwithstanding the comparatively strong light that may be thrown upon, and even into, the bowels of the earth by geological science, and prospecting experience aided by the diamond drill, nature's secrets are so various and intricate that there is still much chance work. However, the present paper is not intended to deal with the problem of finding a mine, but with the successful operation of it after it has been found. While a few mining properties have been, and will be, developed which pay handsomely, in spite of bad management and crude mechanical appliances, by far the greater number of mines of all kinds depend for success or failure upon the method of operation, and even in those which will stand a certain amount of waste, there is no reason why they should not be made to pay better by good engineering.

While the mining engineer should be qualified to lay out and conduct purely mining operations, such as location and arrangement of pits, shafts, drainage, ventilation, etc., he is not usually an expert mechanic. He may understand the general principles of steam engines, pumps, air compressors, and electrical machines, but his calling does not require him to study the details of each of the numerous forms of these machines, and he has not the constant opportunity to become familiar with the peculiar advantages and disadvantages of each, so that he can readily choose the details of his plant, with a clear perception of how they may be combined to give the best results, with the highest economy in fuel, labor and repairs.

The mechanical part of mining consists in providing the best and cheapest methods of drilling or removing rock or ore, transporting, screening, crushing, milling, or otherwise preparing the mineral for further use, pumping, ventilating and other operations which may be accomplished by the use of machinery. First of all comes the power necessary to drive this machinery; this must, in the present state of the machanic's art, be obtained either by means of steam or water power. Whether steam or water will be used, must be determined by circumstances; where water power is not available, steam must be used, but in other cases there may a choice. Where both water power and steam are available, care should be exercised in making the choice. To the superficial observer, water power may be attractive because the water is free of cost, whereas fuel costs money, but it should be kept in view that the cost of building and maintaining dams and other incidental expenditures is frequently so large that the interest on capital and cost of maintenance is equal to, or even greater in some cases than the cost of fuel, and if the stream of water is insufficient or irregular, steam may have to be used to supplement it, or the interruption of work would entail heavy loss.

Having decided upon the kind of power to be employed, the next question is the selection of apparatus. If water wheels, whether they shall be of the "Turbine" or "Re-action" type; if steam is to be used, whether the boilers are to be "Water Tube" or some other type, engines, "Simple" or "Compound?" These are questions which should be decided by a competent and experienced mechanical engineer for each individual case, as they are governed by the conditions, *e. g.* whether the head of water is to be high or low, whether one large engine or a number of smaller ones must be employed, whether the steam is to be carried a long distance, or used near the boilers, and other circumstances too numerous to mention.

In small and medium size mining operations, a mistake is often made in using several separate engines for hoisting, pumping, milling, etc., involving five or six cylinders to be cooled and re-heated, causing a great waste of fuel, when by a proper arrangement of gearing, one large engine of the best and most economical type, could be made to do all the work. There is frequently an enormous waste of fuel from this cause alone.

The next point to be decided is one which is so closely allied to the previous one that it must be considered with it, viz., that of transmission of power, one of the most important subjects in mining, because power must in every case be used for many purposes, and at many places, both above and under ground. I find a tendency among mining men, and even mechanics, to advocate some one form of transmission as superior to others, while the truth is that each form (direct steam pressure, compressed air, electricity, rope driving, belt driving, shafting, etc.) has some special advantage, and is better suited to some particular case than any other. For instance, if a mine were so situated that only hoisting, pumping and perhaps a small amount of drilling, had to be done a short distance from the boilers, it would be more economical to use steam direct than compressed air, or electricity, each of which consumes power in the transformation by compressor or dynamo; if so situated that a Cornish pump may be driven direct from the main engine, or even by a separate engine with early cut off, and reasonable expansion, it would be much more economical than a steam pump, to which steam must be carried a long distance, and used without expansion, as is common with underground pumps.

Compressed air is admirably suited to underground working. It may be transmitted in ordinary pipes having only the average capacity required, and the pressure maintained by means of receivers at almost any distance from the supply. It may be used in ordinary pumps, drills, or other simple apparatus which are easily managed by miners, and in use does not cause any inconvenience from discharge, on the contrary, aiding in ventilating to a small extent. On the other hand, it is attended by considerable loss from the accumulation of heat in compressor, and decrease of pressure by cooling. These losses may be overcome to some extent by compound cylinders, re-heating, etc., all of which adds to the complication of the machinery, and consequent additional expense and care. Electricity is perhaps the most flexible and convenient of all forms of transmission, because by a simple copper wire it may be conveyed long distances and furnish power for pumping, drilling, haulage, etc., or may be converted into light or heat. Since its use for these purposes is comparatively new, there is much room for improvement in the apparatus; and in the presence of gas in coal mines it may be dangerous from sparking or defective connections, but time will no doubt overcome these objections to a very great extent, and render its use as successful and popular for underground operations as it has become for street car propulsion and other uses above ground.

Although it may be necessary or expedient in some cases to use several forms of transmission for the surface and underground working of the same mine, there would be a great advantage in point of economy of fuel, attendance and repairs in using one source of power and one form of transmission for all purposes. For instance, if one or more large steam engines of the most economical type could be used to compress air, or generate electricity, for distant or underground work, and hoist directly, there would be a great saving of fuel over a number of small engines, pumps, compressors or dynamos. A large mine, to a greater extent than almost any other operation, presents constant opportunities for the mechanic's skill and invention, and since there is always a large amount of material to be moved and operated upon, economy is only to be obtained by performing every possible function by mechanical means. The conditions are so varied that the best mechanical knowledge and original invention is required, and the mechanic equally with the mining engineer has the power to make success or failure.

The moral to the invester in mining properties is, make sure of a good mine, under the management of a capable and experienced mining engineer, and to the mining engineer get good mechanical advice and assistance. I have nothing to say against the advice given gratis by manufacturing concerns, which is frequently honest and valuable, if it is not entirely disinterested—but an independent mechanical engineer, who has had experience in mining operations and who is employed directly by and for the mine, should be of great assistance, both in selecting and arranging the plant and in operating it.

A Review of the Report of the Commission on Fires in Pictou Mines.*

By H. S. Poole, A.R.S.M., F.G.S., &c.

In this report we have what purports to be an exhaustive inquiry into the cause, history and effect of fires in the mines of Pictou county. The report itself occupies some thirteen 8 vo. pages, and is supplemented by 90 pages of evidence collected by the Commission. The personnel of the Commission consisted of the Inspector of Mines, Mr. Gilpin, and his deputy for the district, Mr. A. Dick, then employed as instructor of surveying by the Department of Mines, and a retired mine owner of Cape Breton.

Questions had been put in Parliament in the session of 1895, to which the Department of Mines had replied, but regarded as not sufficiently ample, the Commission in question was appointed to investigate further and report.

On verbal instructions the Commission met in May, 1895, and heard a few witnesses. They then adjourned, and obtained formal authority to proceed under Chapter 120, but the document giving the authority was not made public.

The Commission had in this enquiry an opportunity to collect information of considerable interest. The history of the Albion Mines has been most eventful. Success and honors have been won, and troubles, not a few, have been their lot. They have a world-wide reputation for the great size of their coal seams. They have been visited by men of note and acknowledged great attainments. Members of all social ranks from the highest to the lowest have dined and slept within their borders, from the Prince of Wales in Mount Rundel, to the humblest tramp under the shelter of the coke ovens. Science has sent such votaries as Lord Dundonald and Sir Charles Lyell. Here Lord Mulgrave, the Lieut.-Governor, rusticated and threw aside his cares of State. The merrymaking of the colliers at New Year and after pay day, and how rum that had no headache in it was bought by the bucket, would come in also for review. It was here in 1838 the first locomotive ran on a railway in Nova Scotia. Of the mechanical appliances in use the range has been wide, and from the foundry erected in 1828 have issued a varied assortment of castings. Here boilers under but 5 lbs. pressure have been used to supply a Watts condensing engine; waggon and haystack boilers had their representatives. Coal has been here hoisted in skips, and trolleys with wedged wheels have run on angle iron rails.

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* Paper read before the Mining Society of Nova Scotia, March, 1897.

Mr. Richard Smith, before the select committee of the House of Commons, 1835, remarked: "The firedamp at the river boiled similarly to that of a steam boiler, with the same kind of rapidity; so that in putting flame to it on a calm day it would spread over the river like what is commonly termed setting the Thames on fire; it often reminded me of the saying. It is very common for the females to go to the river with the washing they have to perform for their families. After digging a hole in the side of the river about ten inches deep, they would fill it with pebbles, and then put a candle to it; by this means they had plenty of boiling water. I mention this to show how highly charged the coal was with gas. When we first struck the seam at a depth of about 180 feet, the gas roared as the miner struck the coal with his pick; it would often go off like the report of a pistol. The noise which the gas and water made in issuing from the coal was like a hundred thousand snakes hissing at each other.

Then, too, small accumulations of gas were purposely fired without dread of possible consequences, and cannon and butts of water were everywhere on hand to extinguish the fires, that as a matter of course were expected to at times follow powder shots in the more gassy places of the mine.

Notice might also have been taken that here the first blast furnace for the production of cast iron was erected in 1829.

In the memorable contest between the manager, Mr. Smith, and Mr. Young, political strife would find a place; and interesting items respecting trade and navigation would be found in the rates of freight that brought in the days of wooden ships much tonnage to Pictou, and filled the harbor during the shipping season with a forest of masts. The iron interests of New England would not be forgotten, and reciprocity with the United States would be a burning question.

But the Commission did not embrace so wide a field, although they did allow themselves some latitude, and in their inquiry felt unhampered by ordinary rules of evidence.

The departure that they did make, however, was felt to be novel for such a matter of fact subject as coal mining; and their method of treatment proved a surprise, not altogether acceptable to the individuals singled out for notice, of whom I am one. The report, only issued during the closing hours of the session of 1896, could not then be considered by committee, and no opportunity for the aggrieved to be heard could occur until the re-assembling of Parliament. Nevertheless the report was widely circulated as soon as issued, to individuals, to libraries in the province and elsewhere, and in some cases with the author's compliments to societies of which I am a member and he is not. As one of those empaled by this report, but not endowed with such a printing bureau as the Department of Mines at my back wherewith to reply, I now appeal to this Society to grant publicity to my counterstatement. I also ask the Society to consider whether such a departure as this of the Department of Mines, touching the reputation of individual members of this Society, is not one to be jealously watched.

On the re-assembling of Parliament, I appeared by petition before the committee of mines and minerals, and presented a reply criticizing the report as a record of facts, and impugning the findings of the Commission. My reply was accepted and ordered to be filed. When published it will furnish to anyone disposed to inquire further into the matter the authority for the charges I therein make. It gives the ground for contending the whole proceedings were irregular, that the evidence taken was improper, and the findings unsound.

As yet no explanation has been given why the usual practice elsewhere of making such a report as far as possible impersonal has been in this case departed from. It would have been bad enough had the statements made respecting me, a predecessor in the office of inspector, been correct, and the censure indulged in the expression of a competent tribunal. But incorrect I claim the report to be. and I ask you not to be led by it until you have studied the matter set forth in my reply, accepted by the House of Assembly, and ordered to be published with the journals of the House.

In it I give a correspondence with the Department of Mines extending over some years, and extracts from other letters in support of my contentions.

Among others, that while the Report accepted a statement to the effect that the President of the Acadia Coal Co. vetoed a proposition to secure the Foord shaft, I gave his actual reply of February 28th, 1891, in which was the remark: "The Board is exceedingly desirous that the Foord pit should be placed in complete order, and will make the requisite expenditure."

The Report says: "The evidence showed that there was a lack of co-operation between Mr. Wills, the manager, and Mr. Poole, the agent of the company." The tittle-tattle that the Commission collected and called evidence showed a difference of opinion certainly, but no lack of co-operation. What Mr. Wills thought years after he left the company's employ, he had said or done while in it, is not proof, especially in the points in which he is not sustained by the records. His letters I published in my reply are conclusive proof of this. In matters of fact the report in details is often misleading, for example:

It says: "As the fire (at the Drummond mine) was promptly extinguished and work resumed, it was not considered necessary to make any formal inquiry into that explosion." The mines reports for 1873-6 show that the word "promptly" covers operations extending over three years.

The Report, page 4, speaks of a distance of 700 feet or more as "a few yards."

It cuts 1,000 feet off the length of the English slope. On pages 5 and 11 it expresses belief that "the explosion of 1888 in the Third seam extended the fire in the Cage pit seam to the east of the Big

Brake line of stoppings." The fact is the fire broke through the stoppings some six weeks before the explosion.

It implies, page 5, that I held one view in 1872 and another in 1895, respecting ingress of fire to the Cage pit. The fact is it was the head of the Commission himself who wrote in his report for 1883, page 7: "In 1872 its (the main seam fire) smoke was found in the workings of the underlying or Deep seam, at a point where the removal of pillars had allowed the rope to break away up to the overlying seam." In 1895 I showed by plan such was not possible.

The Report says I presented the statements page 98. In my reply page 26, the letter of the solicitor says *he* presented them.

I am made to say there was fire in the Foord pit, although it was full of water at the time.

The Report makes me say, page 74, I never was down the Foord pit. Every one at Stellarton knew to the contrary, and thought it rather strange I should utter so glaring an untruth. The fact was my answer applied to the Forster pit, as the local press correctly gave it at the time the evidence was taken. This substitution of names in the official report makes the implication the more marked, as evidence of me was demanded under oath. A condition not required of many of the witnesses, and in my case an open indignity.

Speaking of the prior publication of the evidence by the local press, it is well to note in the letter of August 8th, 1895: "The Commissioner further states that he has nothing to do with the publication of any evidence tendered before the Commission," and yet the official reporter was the only one present at the inquiry.

In calling attention to this remarkable production I do not propose to say more than sufficient to show its style. Of the evidence appended, its nature and value can only be judged of by examination of the Report itself. On reading what was imputed to me I protested in my letter of August 7th, 1895. It was so grossly inaccurate. As to the evidence of others, I believe it to be faulty, but there are no independent notes to compare with the Report.

It is especially worthy of note there was no cross-examination of witnesses, and in connection therewith that the Commissioner of Mines "was of opinion that in an inquiry of the nature of the Commission *re* Pictou Coal Mine Fires, there exists in no party either a witness or an outsider any right or power to cross-examine any witness that may be summoned by the Commission." Then *he* would claim for Chapter 120, R.S. 5th series, a right to put all sorts of questions, relevent or otherwise, to make all sorts of damaging suggestions, and even accusations, yet acknowledge no right to the party so accused to cross-examine or produce rebuttal testimony. I am happy to say that so far his law has not been sustained.

The claim of the Commission to the right to act under Chapter 120 may be questioned, for the Chapter itself explains it is for inquiry into any matter in which "inquiry is not regulated by any special law." Now it happens mining matters are regulated by the well known Mines and Minerals Chapter and the Mines Regulation Chapter, of which, section 21, the Department of Mines proposed to apply to this inquiry in the letter of December 30th, 1892.

What may be called the practical suggestions in the Report will appeal most strongly, I assume, to this society, and I would especially direct your attention to the more prominent of them.

As one of many examples that may be taken of the soundness of the views expressed by the Commission, I take from page 10 the following: "Evidence shows," says the Report, "that in the burnt mines the bottom coal is untouched. * * * That there is a certain amount of pillar coal left in the upper or worked portion of the seam. The evidence as to the quality of the bottom coal while not conclusive, points to its being workable for ordinary purposes." Now this is what Mr. Smith said in 1835 about this pit: "I worked 25 to 27 bords, six yards wide each, and the ribs of coal three yards. I got the coal out at once, *not leaving it to work over again*, but in the first instance some of the ribs were three yards thick, some two yards and a half, some two yards, according to the weight of superincumbent strata they had to bear. The seam was nearly 40 feet thick; our operations were confined to about 10 feet; the lower part of it was not so good. And this is a part of the field that the Commission would have the public believe can be profitably worked over. Claiming that "every possible effort was made to secure all available information," the Report assumes to have exhausted all sources, and yet evidence might have been obtained from many competent men who had been in positions to know facts relating to these mines: Mr. Hudson, general manager at one time; his son, a certificated manager; Mr. Hall and Mr. Greener, former underground managers; Mr. Rutherford, inspector of mines, 1865 to 1872, and later consulting engineer; then there was Mr. Gilpin and his deputy, whose knowledge and cross-examination would have been invaluable. Nor was reference made to Mr. Gilpin's special report of April 3rd, 1883, or his regular report for that year, wherein he shows that at that time underground fires had existed for 13 years, and long before the present lessees took the Albion area.

The casual reader might assume the censure so generously bestowed applied to only one management, that of to-day, but the operations swept by this review extended over half a century; and the Commission never individually having made mistakes can afford of course to speak censoriously of the shortcomings of others.

A sixth of the Report is devoted to Barriers that were reserved for a time during the many years the pits were open, and that were sometime or other cut and destroyed. The censure on the latter practice is given with no equivocation, and the Commission feel so strongly about it, that not only are they constrained, but "wish to put on record their regret that such a course of connections should have been so persistently followed." As they grasped the situation of what might have been, their language becomes more emphatic. At first they speak of "the importance of isolation of working," which would give, "in case of an explosion, a fair chance of saving one part of the mine," then as their indignation warms the connections "at various times, now appear, they say, so far as information is available, to have been most improvident," "deliberate," "and do not seem to have been necessary at any time."

And then culminating in the charge that "the management, not contented with incurring the risk of penetrating the barrier * * * connected the Deep and Main seams by a stone tunnel;" they finally point the judicial finger and exclaim: "In the present system of working at the Albion Mines, there are now four seams connected, viz., the Third, Cage Pit, Four Feet and Main seams, and it must be remembered that an accident to the works in one seam may mean the closing of those in all three." How very improvident, how very deliberate! I thank the Commission for teaching me how to use these words, they are so apposite. Let me repeat them: How very improvident, how very deliberate on the part of—may I say it—the Commission, to say such things and to charge such things; for both statements happen, will it be credited, to be lacking in essentials.

In the first statement the order of events is transposed, the stone drifts in question were driven in 1877, while the penetrating the barrier and the subsequent explosion occurred three years later, and since Mr. Gilpin became inspector.

Did the Commission remember this when they wrote these strictures? Did they realize that they reflected on the Department of Mines and the head of the Commission, that knew so well as this Report has it of the value of these barriers put away, and yet did not step in and secure their retention.

In the second statement, four seams, the Commission say, are now connected. I ask you, as practical mining men, and knowing all the conditions, would such a course necessarily be bad practice? However, that is not the point at present. The point I wish to make is that the Commission say: "There are now *four* seams connected, and an accident in the works in one seam may mean the closing of those in all three." The Commission name as one of the four, a seam called the Four Feet, but they do not give it in the section of strata they publish on page 3; and rightly enough, for the fact is it is a name only for *a part* of the Deep seam, used conveniently to distinguish it from the main portion. It could not possibly be worked independently, for it is only separated by 3 to 5½ feet of shaley coal. To imply that the Four Feet is a distinct seam is therefore misleading, and it is clear that the four seams the Commission say are worked together cannot be more than three seams. Of the three seams that remain to be considered the Main seam is one. At the time the Report was dated there were no workings in the Main seam, and there are none now in connection with the Third seam. The connections of 1880 have remained since that date sealed by water, so that as a matter of fact the present system at the Albion Mines works two seams together, and not four seams, as deliberately stated by the Commission. As to whether it would be better practice to work the Deep seam and Third seam separately would be a question for experienced men to decide after carefully considering the actual conditions of working. Among which would be seams, of which say 9 to 14 feet may be worked, with at one part but some 45 feet of strata, chiefly tender shales between, and dipping with an inclination of 20° to 30°.

These barriers done away with, that are to carry down the ages engraved upon them the regret of this Commission; did ordinary practice, it may be asked, require them? If retained, they would have made two distinct operations in each seam, entailing inseparably extra expense by so working. Of how much ground do you think? A strip three miles long?—a by no means unusual length; two miles? No! A division of less than one mile, and that in the case of the Third seam not in two equal parts. For in that case the barrier had on the east side only one working balance less than 500 feet wide. For this narrow strip the Commission would have the public believe good practice would have made an independent working. Laying all sham regret aside the width of these workings as they are would be regarded as small in every important coal-producing country; and as yet no such limitation is required or practised in Nova Scotia.

If one may be permitted to adopt the tone of the Report, not among the least remarkable of the many ideas in it that demand recognition for profundity of study and depth of experience, is the recommendation summed up in the paragraph—"The Commission believe that the future mining of much coal in this (the Main) seam, and of larger amounts than at present in the lower seams, would ultimately be secured by the course suggested."

That so simple a method to produce so satisfactory a result should not have previously occurred to anyone to suggest, strikingly illustrates the good fortune of the country in having this whole matter put into such competent hands. That my friends may fully appreciate the difficulties that hitherto have stood in the way, and that this, may I call it inspired, suggestion, have removed, I will briefly mention some of the conditions that the problem presented:—Several thick seams inclined at 17° to 30°, separated for the most part by tender bituminous shales, operated for some seventy years on the bord and pillar system, and with no expectation of the pillars being ultimately drawn; with workings high, from 10 to 18 feet, and even in parts still higher; and with pillars irregular and widely separate, and with openings much fallen and partly crushed; spontaneous combustion a possibility; coal of a variable quality; the face in each seam to be continuously operated as the water receded, of great extent, operated from points of access yet to be established, and finally with smouldering fire unextinguished above the drainage level:—The suggestion presented by the Commission will, I am sure, call for your unqualified delight. This is it, quoting verbatim from the report: "The only effectual method apparent to this end would be the flooding of the workings up to the level of the river. This would involve filling up all the present workings in the lower seams, except the McGregor. When this had been done any fire existing in the crop could be isolated, and the coal gradually worked out as the water was lowered."

I must not, however, forget to mention that the Government, strange as it may seem to be, have not yet compelled the lessees to adopt so wise a course.

It will be noticed that the complaints for having unworked seams and idle pits are made against one lessee only. Let the questions put in Parliament respecting this matter be made general throughout the province, and the impossibility of compliance with compulsory working will at once be self-evident. As to the Commission's views on the working of pillars, it must be remembered this is only now done in Pictou and Cumberland mines, while nothing is said of the pillars standing over thousands of acres in Cape Breton, and that there is nothing in the lease or law requiring pillars to be worked.

The style of the attack in the Report is not altogether new, although it is in this case more sustained. A milder form is to be found in the debate of March 14th, 1888, when the Commissioner of Works and

Mines remarked when the matter of the Albion Mines' fires was again considered: "No doubt the manager was under the impression that the fire was out. The inspector thinks they were wrong about that. However, they undertook to work, and the result was another fire. I suppose one reason why they do not wish to flood the works to put out the fire is that it would seriously interfere with the works, and no doubt the greed of the company operates against such proceedings being taken." The "greed" of a lessee sounds well from the head of the Mines Department, especially when the inspector stated in his report for 1883: "As this part of the outcrop is from 75 to 150 above the level of the East River, *it will be seen that no successful attempt could be made to flood the coal immediately along the outcrop.*" Then as to the remark about the inspector thinking the manager was wrong about fire being out, the Commissioner must have forgotten the special report of April 3rd of that year, when the inspector wrote of himself: "The steps taken by the inspector have led him to consider it probable that the fire in the Cage pit is extinguished."

It is of the same ground that the Commission of 1895 discuss so fully on page 11 of their Report, and finally say: "The Commission believe that in view of the evidence offered, this section only of the old workings (in the Deep seam) would warrant an attempt at re-opening at present."

In doubt as to the exact site of this chosen section, the correspondence given on pages 18 and 19 of the Reply followed, but no response met the repeated request for more definite information. The public is led to believe a suggestion of a practical nature of provincial benefit is made by this Commission in the above extract, but the lessee who would have to give it shape is not told where "this section" lies. The application read: "In order that this company may obtain the benefit and carry out to a practical issue the advice you offer, and free from any possible misunderstanding on my part, I beg to again prefer the request that you return the skeleton plan marked as requested in the letter of Sept. 24th, to show the limits of this section."

This letter remains to this day unanswered.

Notes on some Mining Districts in British Columbia.

By John E. Hardman, S.B., M.E., Montreal.

At the present time, when the mineral riches of British Columbia are attracting so much attention in both Canada and Great Britain, no excuse need be offered by one who attempts to add a little to the general store of information accessible regarding that province; at the same time I desire to preface that it is not my purpose to present a complete description of those districts to which I shall presently refer, but only to record such facts and observations as were obtained during a somewhat extended trip in the summer of '96. The sections to which I shall call your attention are all in the Kootenay country, and are the following: The Rossland Camp in Trail district, the Nelson Camp, the Slocan Lake Country, and the Fort Steele district.

In attempting a description of any of the B.C. camps, one is met at the start with the difficulty that such camps grow faster than weeds, and that the developments of to-morrow may shed a very different light upon figures and theories than the development of to-day, and hence that any description of such a rapidly developing country must be read in the light of such an understanding.

Naturally, by right of size and prominent notice, the Rossland Camp comes first. This camp is situated in the Trail mining district, which embraces an indefinite area, lying upon both sides of the Columbia river, in the southern part of West Kootenay, extending as far south as the International boundary line, and nearly as far north as Robson, with its eastern and western limits not defined. Rossland lies about six miles west of the Columbia river, and about seven miles north of the International boundary, and has an altitude of about 3,500 ft. above sea level. It is built upon the southern and south-western slopes of a hill, draining into the north fork of Trail Creek, which is a tributary of the Columbia. To the west, north and south of it, lie hills on which mineral has been discovered, to the north are Red, Monte Cristo and Columbia and Kootenay mountains, constituting what is known as the North Belt. To the south lie Lake and Lookout mountains, constituting the South Belt. To the west lie Deer Park and Spokane mountains, upon which mineral has also been found. It is therefore a city of six hills, or of seven if we include Lookout mountain, which, however, should really be tributary to the Town of Trail.

The brief early history of this camp shows that the first claim was located by a French-Canadian in the summer of 1889, and was recorded the following May. In 1890 several claims were located, among them the two which have since been developed into mines, and upon whose success the fame of the camp is founded. The first shipment of ore was made in the spring of 1891, from the Le Roi, which amounted to ten tons, and yielded about $86 per ton. Work was intermittent during '91 and '92, but in the winter of '93 and '94 the Le Roi made shipments of ore and began active operations, which have since continued, amounting, according to a statement from the mine officials, in all to about 37,000 tons, of a gross value of $1,500,000. During this period operations were also being carried on upon the Centre Star and War Eagle claims, so that the camp may be said to date its life from the winter of 93-94, and is therefore about three years old.

GEOLOGY.

The geology of Rossland and vicinity is now being worked out by members of the Geological Survey, but briefly it may be said to consist of an area of eruptive rocks, having for a centre a mass of gabbro or diorite, overlaid in part by porphyrite, which in turn is surrounded by rocks which are granitic. The line of contact between this diorite and porphyrite is nowhere clearly defined, but the portion of Red Mountain in which the highest grade ores have yet been found, appears to lie near this line of contact, although further research and the labors of the Survey may change this view. It is not clear that the difference in these two eruptives makes any difference in the grade or character of the ore bodies found along the fracture planes which cut both, but it is a fact to be noted that away from this line of contact no large bodies of high grade sulphides have been opened at this date; and the fact is mentioned rather as one to be kept in mind in studying the district than as one which has been proved to be significant of change of values.

The diorite of this section presents many varieties, running from fine to coarse grained, often (as in the Deer Park mine) affording magnificent crystals of amphibole and actinolite, and frequently showing a variation to diabase by the introduction of augite, and also biotite mica.

The country is much cut up by dykes, which frequently intersect each other, but no extensive faulting on the line of these dykes has been observed. Much development is required yet before the structural geology can be definitely announced.

ORE BODIES.

The ore bodies or deposits of the Rossland Camp appear to lie along fracture planes, which, so far as at present discovered, have two general trends, one nearly due east and west, as in the War Eagle, the St. Elmo and Monte Cristo claims, and another about north-east by south-west, as in the Le Roi and Josie. Along these fracture planes (which are not to be taken as one continuous fracture, but rather as a series of more or less parallel fractures in one zone of country) occur deposits of pyrrhotite associated with other iron sulphides, such as pyrite, chalcopyrite, and occasionally marcasite and arsenopyrite, and also with calcite and quartz.

A minor series of fracture planes, usually, but not always, faulting the larger ones, are found occurring in a general north and south direction or transversely to the main planes which, so far as yet known, do not seem to have been faulting ones. The ore bodies thus formed carry their prevailing mineral (pyrrhotite) in several forms from coarse grained to lamellar and fine grained. In the south belt a change in the filling takes place, both blende and fine grained galena coming in, especially near the surface, and the ore then carries a perceptible value in silver. These deposits of iron sulphides do not always carry gold in paying quantity; in fact it may almost safely be said that the majority of the ore bodies are too low in grade (from $2 to $10 per ton in gold) to become profitable at present rates of treatment; and the ore chutes carrying values in excess of $20 per ton are the exception, which means, of course, that paying mines will be the exception, unless increase of depth may show increase of value, for which idea there is no valid reason, nor is it borne out in practice. Both high and low grade ore chutes are found along the same general ore zone or "vein," as such deposits are locally called; as for example, No. 1 chute of the War Eagle mine, which on the surface gave $12-$16 per ton, and which has never yielded any pay ore with increased depth, and No. 2 chute of the same mine, lying 300 ft. west of No. 1 chute, which has had pay ore running from $40 to $75 per ton, from the grass roots down to the present depth of 250 ft. or more. Where these bodies of pyrrhotite ore have reached to the surface, the iron sulphides have decomposed and oxidized, forming the genuine "gossan" or "iron hat" of mining parlance, and staining by the flow of surface waters much of the adjacent country rock. The inexperienced prospectors of the district have assumed this iron stained diorite to be in all cases the cover of an ore body, which experience has shown to be a costly error, as the diorite of this section contains impregnations of iron sulphides sufficient to form a stain which has received the local name of "Iron Capping," but which is really a very different thing to the "Iron Hat," and which does not have the signigcance attaching to the latter. The length of these chutes, horizontally, varies greatly, running from 40 feet (as in No. 3 chute, No. 1 tunnei, War Eagle) to 172 (as in the Le Roi between the west and east faults), and in the No. 2 tunnel of the War Eagle the ore body had a length of 310 feet, and a width varying from 30 inches to 14 or 15 ft.

It is to noted that all these main fracture planes dip north at angles varying from 45° to 80°, the majority having dips ranging between 60° and 80°. In some cases they appear to be continuous for considerable lengths, even up to 3,000 or 4,000 feet, yet their continuity is frequently broken by faults having a general north and south course, which dislocate the ore bodies from a few inches to several feet; the fault at the west end of the War Eagle having to throw to the south of about 50 feet, and in yet other cases this line of fracture appears to split up into two or three smaller fracture planes, which deviate in course from the original, as seen for example, on the western end of the Le Roi.

Frequently these main fracture planes have lying parallel to them minor fracture planes, which, however, do not have the continuity of the main fissures, but which when clearly defined (as in some parts of the War Eagle mine) have led to the supposition that both walls were present, and that these deposits were of the type of "True fissure veins." In the C. and K., Monte Cristo and Centre Star claims occur six or seven of these parallel fractures, between which are found different types of ore, from extremely coarse grained to very fine grained gray pyrrhotite, also lamellar, bronze colored pyrrhotites, and in one case in the Centre Star a streak of fine grained compact bronze pyrrhotite, with a slightly colored fracture, such as to strongly resemble in appearance a low grade copper matte. Upon the surface cropping of the Le Roi there are apparently two walls, from 5 to 15 feet apart, owing to the parallelism here of two lines of fracture, but in the deeper workings, say from the 350 to the 450 level, one ot these fracture planes disappears, and the main crevice occupies the centre of the large ore body, which at the time of my visit in August, '96, had a width of 36 feet, and which then had for its limits simply the diminution of the sulphides on either side of this crevice, until there was a preponderance of rock over ore.

In addition to these lines of east and west and north-east by southwest fractures, there are the smaller cross fissures with a north and south course already referred to, which in most cases are faulting planes. In some of these, as in the Le Roi, there is brecciated matter composed of diorite, iron sulphides and calcite, and in many others there is only a very narrow crevice or seam, which, as notably in the War Eagle, is frequently filled with sulphides or calcite, or both.

On Columbia and Kootenay mountain are met many examples of segregations of quartz and calcites in the diorite of the country, and it is to be noted that throughout the eruptive rocks of this district local segregations of pyrrhotite, having a general lenticular form, and frequently reminding the observer of gash veins, are common. This is to be expected, when observation shows that the diorite of the district is impregnated with a very considerable amount of iron sulphides which form a constituent part of the whole mass.

The fact, however, that pay ore bodies of iron sulphides occur in these basic rocks, does not by any means imply the reverse, that such basic rocks will always carry paying ore bodies, which implication seems to have been the basis in this district upon which many promoters have formed stock companies.

It is to be noted that along the main easterly and westerly lines of fracture which pass through the War Eagle and Le Roi claims, very little evidence of motion along that line is to be observed ; occasional examples of slicken sides being however found, but no gouge nor breccia. But in the zone which traverses the Cliff, St. Elmo and Monte Cristo, there are many, and distinct evidences of movement.

In remoter parts of the district, as in Champion Creek, I am informed that the seams which constitute the cleavage planes are filled with iron sulphides, which have apparently eaten off the sharp edges and corners of the blocks of country rock.

These facts taken as a whole, are the basis of the opinion entertained by many, that these deposits of the Trail district are replacement deposits, having been formed by the metasomatic action of solutions which have entered the country through these fracture planes (which may or may not at the same time have been faults), and have used these same fractures as channels, by which to dissolve out the more or less shattered country rock, depositing in its place the minerals above mentioned. Whether these minerals have been derived from the surrounding gabbros, or have come upwards with an ascending current from some deep source, is a question requiring further study and greater development.

The absence of two walls of a distinct gangue material, differing from the country rock, and of the usual gouge or product of motion of the walls along the fissure, have precluded many from considering these deposits as fissure veins in the ordinary acceptance of the term. But the fact that these deposits of auriferous sulphides do not present the usual type of a fissure vein, does not in the least detract from their value as workable deposits, nor does it militate against their permanency as mines, for be an ore deposit a fissure vein, a bed, a fahlband or any other of the indefinite number of types of ore deposits met with, its value commercially is dependent upon the continuity of its chutes of pay ore, and facts are not lacking to show that many fissure veins become unprofitable, and are abandoned, not because the vein pinches out, but because the pipes or chutes of pay ore cease—every large vein from California to Montana affords examples of this.

There is in very few, if any, cases a distinct vein stone or gangue; rather the material contained is the diorite of the country impregnated in greater or less degree with iron sulphides; in fact, the vast bulk of the second class ore of the whole camp is of the character described by Mr. Carlyle, in his report on the Trail Mining District, as being a "diorite with a comparatively small percentage of sulphides," but carrying a considerable value in gold. On the authority of Mr. Carlyle's report, this ore has the following composition: $Si O_2$ 45 p.c., Au. 1.34 oz. or $26.80. FeO 22 p.c., Ag 1.4 oz. or 84c. CaO 7 p.c. MgO 3 p.c. $Al_2 O_3$ 18 p.c. $Cu O_3$ 1.5 p.c. S 6 p.c. It is apparent that ore of this character carrying so little sulphur is not favourable to true pyritic smelting, *i.e.* a smelting without any carbonaceous fuel.

The deposits so far as worked (the deepest working being the Le Roi shaft, which has a depth of 500 feet) appear to have an increase in silica as depth is attained, and instances are numerous in which segregations of quartz and stringers of the same material are found alongside of the ore bodies, in the cross fractures, and even in the country rock apart from any fracture. These stringers are often also composed entirely of calcite, and the main ore body of the Le Roi has in places a seam of calcite running along the joint or fissure seam, which runs through the main ore body now working.

The ores of the camp are essentially pyrrhotites, having admixtures of chalcopyrite, pyrite, arsenopyrite, zinc blende and galena in varying proportions, the pyrrhotites as before mentioned having every conceivable variety of structure. So far as observation has gone, the coarsely grained and lamellar pyrrhotites carry little or no value in gold, the finer grained ores carrying more value; yet this distinction is hardly universal enough to constitute a hard and fast rule. In some cases the value has appeared chiefly in the chalcopyrite, in others in the arsenopyrite. In the south bed the sulphides ran high in silver, owing, doubtless, to the presence of galena and blende, which are absent from the north belt. In the Le Roi, Cliff and Evening Star, free visible gold is sometimes seen, and often gotten upon the sieve by assayers.

Up to the first of January, '97, the chief producing mines were the Le Roi and War Eagle. With the advent of the standard gauge railway in December last, the opportunity is now afforded to other properties which are in Rossland opinion equally valuable to become regular shippers. The shipments recorded, however, for the month of January, some 4,800 tons, do not seem to indicate that many of these other mines are in haste to market their ore.

The conditions under which operations are carried on in Rossland such as the hardness of the country rock, prices of labor and of fuel make mining costs high, but owing to the diversity in the size and extent of the ore bodies, and the few mines that have been developed to a stoping point, it is impossible to give any satisfactory estimate of what the average cost of mining a ton of ore is in Rossland ; moreover it is doubted whether any of the properties now working keep such a system of cost accounts as would include in the mining cost the proper proportion of the cost of development work, superintendence and general expense.

The ores are shipped for treatment to smelting works in the United States, and also to the furnaces at Trail and Nelson. The pyrrhotite by itself is almost in the condition of the natural matte, but as the bulk of the ore shipped carries 50 per cent. silica, and only 20 to 25 per cent. FeO, with rarely over 6 per cent. of sulphur, it is, as before stated, not an ideal ore for pyritic smelting, One of the American authorities on pyritic smelting (Sticht) says the process "is always limited to the presence of enough sulphur and iron in the ores to maintain fusion without the auxiliary addition of two much coke—a deficiency of sulphur must be corrected by a greater use of coke"—and the early experience of the Trail Smelter has shown very clearly that the ores it received did not contain any surplus of either sulphur or copper.

PRODUCTION.

So far as I have been able to learn, the production of the Trail Creek District for the year 1896 was 38,600 tons, of a value of $1,100,000, of which $1,000,000 was gold and $100,000 copper. These figures are based on the ore paid for by the smelter, and do not include ore in transit or unsettled for. The smelter returns for 1895 gave a total production of 19,700 tons, worth $702,000, of which $42,000 was from copper, $30,000 from silver, and $630,000 from gold.

The average value per ton for 1895 was $35.63; for 1896 was $28.50.

FUTURE.

While it is improbable that one per cent. of the 3,000 and odd claims located in Rossland Camp will ever turn into dividend paying mines, it is an assured certainty that the camp will have from six to ten, and perhaps more, good permanent ore bodies. With such number, or the half, a permanent population is ensured.

I take this opportunity to note with pleasure the confirmation of these views in the interview with Mr. F. Aug. Heinze, which appeared in this monring's "Gazette," in which Mr. Heinze stated that if Rossland possessed half a dozen good mines, it would have as many as the world famous Camp of Butte, Montana, in which at the present time there are but six producing companies.

I also take the opportunity of saying publicly that a similar interview with myself has been construed as condemnatory of the Trail District. This is a gross misapprehension, as the paper I have just read will show. I sought in that interview to warn clerks, women and dependent persons generally, again indiscriminately purchasing the shares offered by unscrupulous and misrepresenting stock-brokers.

THE NELSON DISTRICT.

The Nelson District includes a large and irregular area. It runs north for 50 miles from the International boundary, including the Salmon River country of recent fame, and beginning west of the lower end of Lower Arrow Lake runs 60 miles easterly nearly to Kootenay Lake.

So far as these notes are concerned, however, only that portion included within a ten mile radius from the town of Nelson will be considered.

The prominent mine of this district is the "Silver King," one of a group of several claims owned by the Hall Mines Co., Ltd. The ore body in this claim appears to be unique in the district, no similar deposit having yet been found.

The country rock of the Toad Mountain portion of the district consists of a series of gray and green schists, which occasionally lose their schistose character and become massive. These schists have many forms, being felspathic, chloritic, hornblendic and micaceous, and in structure are often amygdaloidal. They are said by Dr. G. M. Dawson to be composed of altered volcanic material.

These schists are surrounded by granitic and granitoid rocks of several distinct varieties or periods.

The coarse-grained are evidently intrusive, and of later date than the schists, which are altered by them.

Limestones of crystalline structure are also met with, on both sides of the "West Arm" or Kootenay River.

The copper-silver deposit of the Silver King appears to be a segregation of mineral along a twisting line of fracture whose general course is east and west, dipping southerly at a high angle. From this main body of mineral (whose horizontal dimensions so far as stoping is concerned are about 250 ft. in length by 40 or 50 ft. in width) small veins and stringers of nearly pure mineral ramify in all directions, gradually dying out in the country rock. The mineral contained is chiefly bornite, with chalcopyrite and pyrite in smaller proportions near the surface, and in larger proportions as depth is attained, apparently confirming the theory that bornite is the result of alteration of the chalcopyrite.

The grade is low, the average being about 4 per cent. of copper and 22 ozs. of silver to the ton.

It would appear that closer work at the mine could raise this grade considerably without much extra cost.

With the exception of this copper-silver deposit, the claims worked in the district are on gold bearing veins, which belong to the type of fissure veins, being well defined, cutting cleanly through the country rock, possessing two distinct walls often carrying a gouge, and filled chiefly with gangue material of clean vitreous quartz, carrying copper and iron pyrites. These veins appear in a grey coarse-grained granite, having many variations in its constituents (being frequently a mica syenite), and seem to be mainly confined to the area between 5 Mile Creek on the east and White Water Creek on the west, getting their greatest development at or near the head waters of Eagle and Forty-nine Creeks. These quartz veins carry from $10 to $30 in value of gold, being free-milling on the surface, where the sulphides have become decomposed, and being refractory below this line of decomposition; the value being contained chiefly in the sulphides. Their width varies from 15 in. to 5 ft, but with the exception of the "Poorman" and "Fern" mines, so very little work has been done that no safe predictions as to the continuance of the pay chutes is possible.

These gold veins have produced some very fine samples of specimen quartz and gold, and their future systematic development will doubtless be productive of profitable results. Operations on this line have recently been begun upon one lode (the Athabasca) which so far have been productive of highly satisfactory results.

Below Nelson, on the opposite or north side of the Kootenay River, occur peculiarly formed somewhat massive deposits ("Victoria" and "Copper King,") apparently segregations in a granitic rock, carrying much copper, and a value in gold.

So far as production is concerned, the district hitherto has been a copper-silver one, from the predominating value of the Silver King ore. But there are grounds, as stated, for the belief that the gold yield will be substantially and steadily increased.

The production of the section for 1896, so far as I have been able to learn, was about $540,000, made up of $420,000 worth of silver, $110,000 of copper, and about $10,000 in gold.

It is needless to say that the completion of the Crow's Nest Pass Railway to this point will give to this section unusual advantages for cheap transportation and fuel, and permit the successful working of many properties that are now only undeveloped claims.

SLOCAN LAKE DISTRICT.

The section referred to as Slocan Lake District is a part of the Slocan District proper, but comprises that portion running south from Four Mile Creek to and including Lemon Creek, and reaching from the lake shore as far easterly as the divide between Slocan and Kootenay Lakes

Its dimensions, therefore, are not great, being about 20 miles long by 7 or 8 wide, but its possible developments are enormous.

In contra distinction to the Slocan proper, it is characterized by a preponderance of dry ores, whereas the argentiferous galenas predominate in the Kaslo-Slocan country.

It is worthy of note also that gold values in the ore appear to increase as one proceeds southerly from 10 Mile Creek, some free gold quartz veins having been discovered on tributaries of the Lemon Creek.

From the territory drained by Springer Creek some remarkably high assays have been obtained, 700 ozs. in silver and $90 in gold having been obtained in one case, while assays of 150 to 200 ozs. silver and $15 to $25 in gold are common. Some small shipments have been made which yielded from $70 to $160 per ton net to the owners.

The country is high and mountainous in this section ; the summits rising to 7,000 or 8,000 feet above sea level, or 5,000 to 6,000 feet above Slocan Lake. The first discoveries were made in the fall of 1895, but the bulk of the claims have been located during the summer of 1896.

The country rock in this district consists of shales and slates to the north, with gneisses and granites coming in as one proceeds to the south, the country about Springer Creek being granitic. The veins lie at a low angle near the surface, being from 28 to 40 degrees from the horizontal. They vary in width from six to seven inches to about three feet. The paystreak, however, is confined to one wall (usually the hanging wall) and has a width usually not exceeding six inches, and in some cases being as small as three inches.

The ores, as stated, are of the kind usually classed as dry ores, but the development of the Enterprise Mine on 10 Mile Creek has shown that, contrary to the usual law in the Slocan country, zincblende may and does carry very high values in silver.

Although this section is quite distinct in the character of its ores and country rock from the Slocan District proper, its production will be credited to the Slocan country, and before passing to the last district to which I shall refer, I desire to give you an idea of what this unboomed, unnoticed Slocan District did for British Columbia in 1896.

My information gives the following figures :—

Gold	$ 3,000
Silver	1,500,000
Lead	550,000
Total	$2,053,000

If to these figures we add the production of Ainsworth, which belongs to this section through similarity of ores produced, we get :

Silver	$125,000
Lead	60,000
	$185,000

or a grand total of $2,238,000. Such a district needs no newspaper boom.

FORT STEELE DISTRICT.

The Eastern Division of Kootenay was one of the first portions of the Province to receive attention after the advent of the C. P. R. through Kicking Horse Pass. But the galenas of the Otter Tail and of Mt. Stephen, the free gold and copper silver ores of the Spillimicheen, and the copper ores of Jubilee and Windermere, have never proved remunerative, and soon ceased to attract the attention of the prospector and the capitalist alike.

Farther to the south, some years ago, the enormous ore bodies of the North Star Mine, on a branch of the St. Mary's River, drew attention to the southern portion of East Kootenay, but so far as vein mining is concerned, Fort Steele District may be regarded as a new country.

The Placer excitement in Wild Horse Creek, in 1863, carried in thousands of men, of whom but a handful remained, and they chiefly concerned themselves with gravel diggings, and not with veins of ore.

In ascending the valley of the Columbia, to the south, the main range of the Rocky Mountains seems to carry mineral, but in too disseminated a form to be profitable. As soon, however, as one passes the little ridge at Canal flat, which forms the dividing line between the waters of the Columbia flowing north, and of the Kootenay flowing south, a change occurs in the rock formation, and slates and quartzites become more frequent, taking the place of the limestones and dolomites.

And in the course of the next 30 miles proceeding southerly, the western slopes and spurs of the Rockies begin to show quartz veins, carrying ores of gold and silver, such as tetrahedrite, galena and the black sulphurets of silver. Veins of milling ore, of free gold quartz, are also met with in the tributaries of Wild Horse Creek. The basins of the creeks from Wolf Creek to Bull River are now being prospected, and sufficient work has been done to justify the belief that development will show many of these veins to contain profitable ore.

On the western side of the Kootenay the Purcell Range of the Selkirks shows easy rounded summits of from 4,000 to 5,000 feet altitude, and from the eastern slopes of these mountains run three streams, the St. Mary, Perry and Moyie Rivers, whose watersheds are now receiving a good deal of attention from prospectors, and with the most promising results.

Along the St. Mary's River and tributaries are found ores of argentiferous galena, and of grey and yellow copper, with satisfactory amounts of the precious metals.

On Perry Creek and its tributaries are found wide veins of quartz, some cutting the formation like true fissures, and having a width which delights the lover of large tonnages.

On Moyie River and its branches occur a number of true fissure veins, carrying galenas, grey copper, and also on Weaver and Ryder Creeks, free gold. The Ste. Eugenie group on this river presents a type of vein similar to those found in the Slocan district, having a strike across that of the formation, presenting two clean walls, and carrying argentiferous galena of a high grade.

Enough has been done in this district to warrant the most pessimistic observer in predicting a very substantial if not a brilliant future.

It will be evident from these very crude notes upon the districts mentioned, that no one camp in British Columbia can as yet proclaim itself " the " camp of the province, and there are many other districts which I have not mentioned which may shortly come to prominence as permanent producers.

There are climatic and topographical reasons why British Columbia cannot develop her mining regions as quickly as her neighbors to the south, but give her five or ten years time, kill the over-capitalization of stock companies and the illegitimate boom, safeguard the investor, and there is no question whatever but that British Columbia will shine as the brightest gem in the whole Dominion crown.

The Economics of Joint Stock Companies, and the Laws Relating to their Incorporation.

By Mr. J. BAWDEN, Barrister, Kingston, Ont.

Is the system now in general use in Ontario and British Columbia for floating or converting into cash the stock of mining companies a proper system? Is it the best that may be devised from a financial point of view? Is it correct in method from a legal point of view?

The object of company promoters is (1) either by the sale of shares to sell their property for the highest obtainable prices, or (2) to convert a part of the interest into cash, and acquire working capital for the development of the remaining interest, or (3) solely to obtain working capital. The first of these objects is legitimate, though framed to attain indirectly a result not directly attainable; and any interference with lawful methods for attaining it will be opposed by the commercial spirit of the age, which says to buyers of every degree, "let the buyer beware." The law interferes only to protect men's stomachs from adulterated food, not by any preventive process to protect from pickpockets in the guise of vendors of valueless shares.

The question, whether in the interests of the public it is advisable to interfere with the right to sell valueless shares lest individual liberty and the inalienable rights of British subjects be imprudently invaded, is a question of expediency which those who have at heart the development of mining enterprise may discuss without a tilt with brokers or jurists. The sale of worthless shares injuriously affects the sale of valuable shares. It goes without saying that capital seeking investment in mining shares is a limited quantity; that it is coaxed out of hoards, at the cost of much wind in the form of reports, advertisements, puffs, editorials, and that the characters of many people are staked upon representations, sometimes made in good faith, but too often discredited by adverse results. The argument therefore against the legality of the sale of worthless shares is founded on the economic ground that the business should be prohibited by legislation because it will work irreparable injury to honest enterprise.

Unless the mining industry of this country is able to establish a character for fair dealing, it will be a moral boon to mankind to send the whole mining constituency to some warmer climate, where the temperature may generate conscience ; a moral boon to let the world know that fraudulent corporations are not prevented from obtaining a legal status in this country.

The law of limited liability, while it guarded shareholders from the consequences of corporate trading in excess of ability to pay, also secured to creditors execution against any sums due to the company on the issue of shares. The capital announced was therefore, in general terms, a measure of the money required as working capital. The prudent promoter avoided an over issue of shares beyond the capital required, because idle money will not earn dividends ; at the same time care was taken to call in enough capital to avoid the costly necessity of borrowing, or to avoid a deficiency of working capital. The nominal capital had some relation to the business in view, and was usually an estimate. Industrial stocks cannot be put on the English market without estimates carefully prepared by chartered accountants. The plan of organization of such companies leaves nothing to be desired in the way of reasonable safeguards for the protection of shareholders. The result is that although a percentage of " industrials " are failures they are not only the favorite stocks in Great Britain, but they have done much, as joint stock companies are eminently fitted to do, to promote the great commercial prosperity of the " tight little island."

The sale of bonds below par had been cited to justify the sale of new stock below par. The quotation of the former has always some relation to the rate of interest the vendor is willing to pay ; and being ostensibly a security of fixed nominal value issued under legal sanctions, the buyer owes it to his relf-respect to investigate the security offered. In the case of shares the investment offered has none of the characters of a bond. The share certificate neither binds nor obliges any. In fact there is not a more innocent, vague, unrepresentative, and yet plausible piece of paper in the world than a mining share certificate.

It may stand for a share in a mine which has no existence, for a part of the capital of a scheme which never had and never will have a dollar in its treasury, or it may represent the title to a share in a bonanza honestly administered, paying the largest profits ever realized, and be good documentary evidence of the ownership of value many multiples of the money share stated on its face.

The issue of stock in small shares was condemned many years ago by English judges, on the ground that it encouraged the promotion of bubble companies. The danger is perhaps less to-day than in the time of Lord Eldon, owing to the enlightenment offered by the press. The source of protection, however, is one of danger, and it must be remembered that it is wholly irresponsible. A reckless or mercenary correspendent may, innocently in the one case, or fraudently in the other, spread false information, which may take from the seamstress her savings, the clerk his hoard for the wedding and house furnishing, from the mechanic his provision against rainy days and storms; for all which injury the sufferer will have no redress. The issue of small shares works injury by the encouragement of a class it is most desirable to deter from mining investments. It can only be to tempt and encourage the holders of small savings to invest in mining stocks that shares have been made of such small nominal value as five cents. The business man is not beguiled by any such art of the broker, as to conceive for a moment that his position as the holder of 1,000 five cent shares in a million dollar company is one whit different from the holder of fifty one-dollar shares in a company of fifty thousand dollars capital. Given two companies with property of equal value, he would probably prefer that of the smaller capital.

The Stock Corporation law of New York State enacts that shares shall not be less than five or more than one hundred dollars; and that "no corporation shall issue either stock or bonds except for money, labor done, or property actually received for the use and lawful purposes of such corporation. No such stock shall be issued for less than its par value. No such bonds shall be issued for less than the fair market value thereof."

The enticement of Lilliput, with its picayunes and pence, into the mining world will only make the howling louder in the event of disaster. The failure of half a dozen mining companies among so many would be deemed no unusual occurrence by the ordinary run of buyers of mining shares, but when the losses fall on those who in the nature of honest things should have been dissuaded or deterred from investing, the cry will be bitter indeed.

The promoters of honest enterprises who have fallen upon this mode of raising capital may have been encouraged by the facility it afforded. They have, however, not only paid enormous percentages for brokerage, but have laid the foundation of future peril for any interest they may have retained in the property, by creating a large and unmanageable constituency. The sale of a mine, often the most advantageous way of getting rid of unsuccessful managers, may be hindered very effectively by a few opposing shareholders insisting upon their right to maintain their investment in a particular property; and strangely enough the opposition is often in inverse ratio to the interest of the discontented. While five cent stocks have usually been sold in blocks of not less than 100 shares, their is nothing to prevent their transfer among 100 holders. It will be comparatively easy to crowd out any business meeting by the transferees of a very small minority of shareholders, whose physical force may make up for lack of voting power.

There has been invented the curious device of selling parts of the stock issue at varying prices—a feature antagonistic to the principle of joint stock company organization, that shareholders shall share equally in their contribution to the enterprise. The creation of preference shares, it is true, is opposed to this principle, but is justified or excused on the ground that it may be necessary to offer preference in the nature of security in order to obtain capital for working operations, or to provide for some pressing liability. The issue of dollar stock at five cents with the notice that the next issue will not be less than ten cents or more is an invention which would have met prompt rebuke from the courts in days gone by. Promoters would have been told that if it was conceded to them to sell stock at a discount the concession implied a uniform discount. But to sum up the suggestions which suggest themselves against this mode of raising the wind for mining operations, that which should most seriously engage consideration, is that the word "capital" becomes a misnomer, a term of no value in fact either in the prospectus or in the accounts of a company selling various issues of stock at prices regulated by the brokers. While every reasonable and honest facility should be afforded for raising money for working mines, to allow a company to characterize as its capital of $1,000,000 the shares which it has authorized its brokers to sell for $50,000, less a large per cent. for commission and other expenses, is to allow the use of misrepresentation. Where a company has done this it should be compelled in every case to print the amount of the actual capital under the nominal capital, and in future no issue of stock should be allowed at varying prices below par. On every share certificate or other document, in every advertisement, under the words and figures stating the nominal capital, the amount of the actual capital raised or intended to be raised should be made to appear.

It is an economic law that the value of a stock is greater in proportion to its security than in the ratio of its profit. It is a cognate law that the cost of obtaining capital by the sale of stocks increases in proportion to the hazard of the investment offered by the stock. It is therefore of the first importance to give the buyers of mining shares legally sanctioned guarantees that the following elements are inherent in the shares:

1. That the mining company had on its incorporation a good title to the property described in its prospectus, or in the case of a development company formed to buy and develop mines has at least ten per cent. of half of its capital paid into the company's treasury.

2. That every agreement made by the promoters which calls for a payment out of the company's capital is referred to in the charter, and is open to the examination of the public, and that every broker selling stock in such company is supplied with copies for perusal by intending buyers.

3. That share certificates shall in addition to the nominal capital state the amount of subscribed stock at the date of issue of such cer-

tificate, the amount of subscribed capital paid in cash, or by the sale of land to the company, the amount of treasury stock to be sold, and the price thereof fixed by the directors.

4. That the company's treasurer has given the indemnity of a guarantee company for the faithful performance of his duty, or that the proceeds of treasury stock are to be administered under the scrutiny of a trust company.

Further consideration of the economics of joint stock companies is so much involved with matters of necessary legislation relating to their incorporation that their discussion will come up under this head.

I invite the provincial representatives of the mining interests of the Dominion to make it their duty to promote uniform legislation upon the incorporation and government of joint stock companies among all the provinces of the Dominion. Let there be a uniform code of joint stock company law from the Atlantic to the Pacific, and if this cannot be comprehensive enough for the whole scope of joint stock company enterprise, let it at least embrace all mining enterprise. The department of Trade and Commerce, exercising a function of the British Board of Trade, with the assistance of the provincial law departments, might readily consummate this great object. There is no reason why we may not in this law-abiding country offer to the world a simple yet comprehensive, liberal yet widely efficient, method of Joint Stock incorporation and Regulation, which will secure the rights and the property of picayune shareholders as well as of more substantial capitalists. In the pursuit of this end let us steadily keep in view two things. (1.) That security of investment is the most important of all factors in the promotion of mining enterprise, and that the clamor of certain brokers and speculators for financial facilities and license for tricks upon travellers must be stoutly opposed; (2) that our labors shall not weave redtape and legal machinery and friction for the wheels of mining enterprise. To enconrage us in labor for these objects there are some flushes and streamers in the sky which stimulate the fancy and beget the hope that we Canadians are near the dawn of the greatest development of mining enterprise which has ever visited any country.

1. I propose to touch cursorily in order some of the enactments and amendments required in a code of Joint Stock Company Law.

1. *Notice of Application.*—This should be abolished because unnecessary. Notice of incorporation only should be required.

2. *Scope or Objects of Incorporations.*—English law permits the grant of a charter " for any lawful purpose." Some provincial scrutiny has been suggested, *e.g.*, that the purposes or objects of the company shall be cognate. This suggests departmental discussion of the business to be operated by the company, a matter which so long as the purpose is lawful, no departmental deputy or head has the least right to discuss or question. Let men under the grant of a charter pursue collectively any business enterprise they may lawfully pursue as individuals. At the same time let the objects of incorporation be set out always on the face of the share certificate.

3. *Capital.*—Incorporation has for its main purpose the acquisition of working capital, which included the first cost of the mine, the cost of raising the required sum, and the reward of the promoter. The latter element is difficult to eliminate or to control within reasonable limits. It knows no bounds of law, reason or honesty. It is the most highly paid and perhaps the least serviceable commodity in the market. The most practicable plan of dealing with what of evil there may be in the scheme of promoters is to bring them to the light, that is, to require, as is the practice in England, that all agreements respecting the sale of property to the company, and the division of the capital among the promoters, shall be referred to in the prospectus, and shall be open to inspection. The fullest information about ground-floor operations must be afforded the public. Payments in shares to promoters, directors and others concerned in getting up companies should be declared simply null and void, unless disclosed in the prospectus and made public in any announcement of the sale of the treasury stock. The non-assessable character in all the provinces of all mining shares not paid by instalments should be declared as it has been in Ontario. If traders will give credit to mining companies it should be clearly understood that their only remedy in all cases is against the company's personal property, not against shareholders. The non-assessable char-

acter of stock should always carry with it this warning on every share certificate, that under the Joint Stock Companies Act the capital stock may be increased by a majority vote, and such issue may be made a preference stock, and that the company's property may at any time be mortgaged or bonded by the majority.

When stock is divided in a company's scheme into proprietary and treasury stock, without any cash contribution from the holders of the first-named, and the latter being the smaller share interest, there should be some provision that the shareholders, whose money is risked for development, shall not be sacrificed if the company is wound up, or a new issue of stock called for. That the law may not interfere to make a contract for those who will not protect their own interests by a safe contract is generally admitted. At the same time there is no mutuality of contract in the case mentioned. Let the treasury stock be exhausted; it is just possible the mine may be a good one, and the creation of new stock for working capital quite legitimate. It should not in such case be in the power of the holders of the majority to clean out the minority by the issue of preference shares or of bonds. The proprietary shareholders should in such case cancel an equivalent part of their stock, and unite the holders of treasury stock in the issue of new preferred stock. Other methods of securing the interests of the minority will suggest themselves according to circumstances. One thing is clear the law should interfere to protect those whose cash has been risked for development on the representation of the promoter who has controlled the management and expenditure of the mine.

ACCOUNTS.

I pass from the discussion of the subject of registration of shareholders and mine officials, which should be reduced to a complete system, and without reference to minor but necessary amendments, to the subject of "accounts." Under this head all mining officials should be placed in a fiduciary relation to shareholders. The system of bookkeeping which should be followed by every mining company may hardly be the subject of legislation. The department issuing charters may, however, recommend a system of accounts and provide forms. They may legislate to require returns readily made up from such forms, and impose penalties for failure to make returns quarterly. The British Board of Trade appoints an inspector of a company's accounts on the petition of the holders of one-fifth of the shares. This might well be granted on the petition of a less per cent. of the share interest in the case ot companies carrying sky-scraping decimals in nominal capital. Official auditors in every province should be, without petition, directed by the provincial departments to investigate accounts where the quarterly returns may be found incorrect. Interference in business management should be avoided as much as possible, and where correct balance sheets shall be made quarterly there will be no ground for interference except under criminal circumstances. The adage that "good book-keepers never become bankrupt," if made the basis of reasonable legislation will go a long way to help in the practical management of mining companies, protect shareholders, make money easily obtainable for sound mining enterprises, and win for Canada the fair renown that honest mining companies are not "abune the micht" of Canadian law.

DIRECTORS, THEIR POWERS, LIABILITY FOR FALSE STATEMENTS IN PROSPECTUS.

Provision should be made that directors shall be liable for company debts in excess of the actual cash capital; that their acts shall be void beyond the year for which they are appointed; that they shall be liable for any issue of bonds or hypothecs in excess of two-thirds of the actual cash capital, with other provisions in the stock corporation law of New York. The liability of directors for false statements in prospectuses and advertisements is probably as extensive as necessary, although there is some difference of opinion on this subject. As a general rule the so-called mining expert is in cases of misrepresentation the chief wrong-doer. This evil will, it is hoped, diminish with the increase in members and respectability of the profession of mining engineers. The director is as often the dupe of the expert and prospector as the means of luring ignorant shareholders. The engineering profession owe it to themselves and to the best interests of the country, that they shall have a registered membership. The expert's report protects the director who uses it, but who protects the shareholder and director against the expert? The latter is the party who is assumed to know, and his professional fee is sometimes intended to guarantee that he does know. It is quite right that the fee should bear some relation to the responslbility, but then the responsibility should not be impecunious. Some guarantee should be afforded that the report on a mine is made by a competent expert, or the fact if otherwise should plainly appear. If directors will stake their reputation and base their confidence on the reports of experts who have no solid reputation or decent bank balance, should they not, who ought to have inquired into the truth of their company's prospectus, suffer rather than shareholders? I repeat that in the majority of cases of fraudulent prospectus I believe that directors have been deceived, and that there are forces in operation which will soon rid us of the arch-enemy of mining enterprise. Our universities are giving us a yearly generation of competent experts, whose reports will be found reliable. We shall have ere long a registered body of mining engineers, zealous for the reputation and honor of a learned and noble profession, from whose lists will be struck off any one found guilty of unprofessional conduct.

Buckley, commenting on the English Act, of which the Ontario Directors' Liability Act is a copy, says that "if the competent expert was fraduleut and his report false, and the person attacked under this act knew it to be false, he will escape so far as this act is concerned." The remedy will be under the law as it exists outside of this statute, by which any person is liable for untrue statements upon which another has acted to his damage.

The attention of the Minister of Justice might be directed to the necessity for criminal legislation as a means for preventing the operations of pretending or fraudulent experts. The subject is one which I submit should have the consideration of the profession of mining engineers.

Duration and Winding-up of Companies.

The number of years for which mining companies shall hold their charters requires amending legislation. It will greatly promote investment if in ordinary cases charters shall be granted for ten or twelve years only, provision being made for a simple form of renewal for a longer or shorter term as circumstances require. In cases where the property has not been developed, or the mine closed for a period of five or seven years, the property should revert to the Crown to be sold, the proceeds to be distributed among shareholders. Where companies obtain land from private owners they should be required to convey to the Crown and take from it a title subject to this reversion. The law of Ontario respecting winding up companies leaves little to be desired, except that some of its provisions might be simplified. In addition to the grounds provided a company should be wound up at the expiration of two years if unable to pay a yearly dividend of four per cent. on paid-up capital, unless three-fourths in value of the shareholders by resolution vote for continuing work one year longer; but in the event that three years shall have passed without such a dividend the rule should be: "Cut it down, why cumbereth it the ground?" The reverter of property to a vendor who has sold in fee in the case of a company becoming defunct should be taken away, and the property should revert to the Crown.

SHARE CERTIEICATES.

These documents should not contain the minimum of information with the maximum of engraver's decoration, but should inform the shareholder in a concise manner what are his rights under the charter. As for example among other things that on petition of ten per cent. of the treasury stock the holders may obtain an examination of the accounts if refused by the company; also that in the event of a proposed sale of the property by a majority of the shareholders the holders of a minority of the stock may require the value of their shares to be ascertained by arbitration; with other matters which should be endorsed on the certificate or appear on its face.

REGISTRATION OF COMPANIES.

Companies incorporated in any of the Dominion provinces other than that in which they carry on business, and all foreign companies should be allowed to acquire mining property anywhere in Canada (subject to the preceding clause respecting duration of title) upon registration of their charters, with a list of shareholders and statement of paid-up capital, assets and liabilities, in the Provincial Mine Department or Bureau; subject always in the case of foreign companies to their conformity to the law relating to "accounts" and audit, as if incorporated in this country.

BONDING POWERS, REMEDY OF MORTGAGEES AND CREDITORS.

The power to bond or mortgage under the Ontario Act is extraordinary. It is limited only by the vote of two-thirds in value of the shareholders "present" in meeting called for the purpose, not by the vote or written consent of the owners of two-thirds of the stock, as is the case in New York. The limit at which bonds, debentures or other securities of an Ontario company may be sold is "at such price as may be deemed expedient or necessary." In New York the bond or mortgage must not exceed the paid-up capital, or if the property of the company is greater, then two-thirds of the value of such property, with this safeguard that directors are made personally liable for bonding the company's property beyond the lawful limit. Our own Dominion Act limits the power to hypothecate to 75 per cent. of the actual cost. It is difficult to find a reason for the difference between the Dominion and Ontario Joint Stock Acts in this respect as well as for the difference between them in this, that the Dominion Act requires 10 per cent. of half the capital stock to be paid before grant of charter, while the Ontario Act has no such provision.

For the protection and security of lenders, provisions respecting mining companies mortgages, similar to those under the Railway Act of 1888, are required. Under this authority will be given the trustee of the mortgage to appoint a receiver of a mining company, with power to run the concern or sell it, as circumstances may warrant. It is obvious that in mining districts a magistrate should have power to direct the audit of accounts on petition, and to direct the management of mines by a receiver at the instance of mortgagees, and with other functions. An administrator of mines would be the executive of such judge or magistrate. He should give security for the faithful performance of his duties.

Officers capable to audit mining companies accounts and to direct the financial management of mining affairs in the case of defaulting companies would beyond question be of great service to debtor concerns as well as their creditors. There is a useful provision of the New York code that a shareholder may by paying a contribution to the mortgage debt in proportion to his stock, be subrogated *pro tanto* to the rights of the mortgagee.

MINING PARTNERSHIPS.

The provision of the British Columbia law for the formation of mining partnerships is an admirable adaptation of the Cornish cost-book system to the environment of British Columbia, and might be profitably introduced elsewhere through the Dominion.

The scope of the title of this paper is so comprehensive that I must crave indulgence for the omission of many heads of the subject which may be thought to require discussion in view of the demands of the hour, but to avoid excessive tediousness, I make a comprehensive reference to Imperial and American legislation as sources for many necessary amendments. The Joint Stock Company Limited is the creation of statute law having no status or function that is not within the control of the State. It is therefore beyond question all important that the creation shall be efficient for all beneficent use, and capable of immediate check and regulation in any direction in which its powers may be invoked for evil purposes.

Before the first half of '97 shall have passed it will probably be known whether or not certain members of the Huronian formation in Canada are everywhere gold-bearing rocks. If the certitude shall be golden it will bring the country face to face with enormous treasures, which under modern modes of thought do not practically belong to the nation. Evolution has not yet brought us to that level that as a nation we are able without calling on private picayunes or foreign dollars to work our mines as national property, and with their treasures build railroads, endow colleges and libraries, promote scientific investigation, erect beneficent institutions, reward inventors and artisans, and pay for all these without taxation, while at the same time stimulating manufacturing industry beyond the dreams of enterprise or avarice. Perhaps we should not complain that evolution is tardigrade, because the character is our own. It is still true that where the carcass is there are the eagles. If we must surrender the "chief things of the ancient mountains and the precious things of the lasting hills" to the cormorants of the exchange, we should at least endeavor to have the spoliation of national property so governed and regulated that the work shall be done decently and in order, so that if public interests must suffer private right may nevertheless prevail.

DISCUSSION.

MR. W. R. WHITE, Q.C., PEMBROKE.—Mr. Bawden was kind enough to send me a copy of his paper some days ago, but as I happened to be away from home I did not have sufficient opportunity to peruse it carefully enough to discuss it as it ought to be discussed. It seems to me that the paper is full of very valuable suggestions indeed, and many of these suggestions strike me as being almost of public importance. I suppose all of us, whether miners or not, are face to face with the fact that there are a great many schemes being put on the market now, not for the purpose of extracting gold from the rock, but money from the people, and I presume that Mr. Bawden's position is very like that of any other honest man in the country; he is desirous of preventing this as far as possible. I differ from him, however, as to the course to be pursued. I do not think it possible to surround the incorporation of mining companies with such safeguards as would prevent such schemes being put upon the market, and being eagerly seized upon by those who desire to invest their money in a gambling proposition. But there is a law which prevents stealing in this way as well as picking pockets, and I think the whole thing could be crystallized or put into a nut-shell in this way: we have a clause in that portion of our criminal law which punishes those who make false statements in reference to any scheme of this kind, but I think Mr. Bawden will agree with me in saying that even it does not go far enough at present, and I think it is quite right for this Institute to take the necessary steps to have the law amended. As I understand the law at present it touches only the promoters of the company. Now the question is, what is a promoter. We all have different ideas in regard to what a promoter is. Is the promoter the man who comes with the nice prospectus of the company already incorporated and asks you to take stock in it, informing you that he has a report from some person calling himself a mining engineer or mining expert ? Now all these persons can be reached if the law was in the position I think it ought to be in, and would include in its scope any person who sells shares as well as the promoter of a mine or those who put stock on the market, to include in fact any person who makes a false statement with reference to any detail of the scheme he is putting on the market. It is really nothing more or less than obtaining money under false pretences. It is reprehensible that Canada should be endangered by fake schemes being put upon the market. It seems to me that one great difficulty is that the people either do not know the law or do not put it into operation. Now there is another question that has struck me with considerable force since I have taken any interest in mining, and that is the idea of having mining experts and mining engineers formed into a body and incorporated, and placed in such a position as to be responsible to the public. I cannot see how that can be made practicable. It seems to me that, belonging as I do to the legal profession, as Mr. Bawden does also, that if one of you gentlemen go to him he may give you an honest and perhaps sound opinion upon any question submitted to him, and if the person to whom you are opposed comes to me I may give him an opinion directly to the contrary. That occurs every day. Even leaving lawyers out of the question, judges themselves differ upon the law. We all know that. Therefore why should not two mining experts differ upon their estimate of the same property. I do not know, but I am told, that there are mining experts or engineers so skilful that they can go to a property and tell you whether it is going to be a mine or not. My little experience, extending over the past few years, is that mining experts differ upon that question just as lawyers do. I think all those interested in mining will agree that there ought to be some organization whereby a man would be placed in the position that he would be known as a mining engineer. I do not agree with Mr.

Bawden's position when he speaks in regard to the institutions that are turning out young men. I do not think these young men when turned out are competent to do much more than push a barrow in a mine. They may get technical knowledge, but they require the practical experience before they become mining experts or engineers; they are like every other profession in this way. I thought myself considerable of a lawyer when I first started out in business, but I could not convince the general public of that fact. It is only after going out into the world that we find out what we do not know and how much we have to learn. It is, however, much easier to critise than it is to compose, and I am merely expressing the opinion of a tyro in mining, but one who has the welfare of the country at heart. Every person, whether in Nova Scotia, Quebec, Ontario or British Columbia, ought to take a deep interest in this matter, and see that what we do in connection with mining should be done on strict business principles in so far as it is possible. Now it seems to me that the comparison between industrial corporations and mining corporations is not a fair one. If you take an industrial corporation you know what you have got. Let us take timber limits; any expert can count his trees and see what he has got, and he knows whether it will justify him to improve the stream so that he can bring his timber down to market. So with any other industrial scheme, or any manufacturing scheme. All these things can be made a matter of account; an accountant can tell you just exactly what is in it, but you cannot do so with any absolute certainty with regard to mining. You have to spend money in the first place in order to find out what you have got and whether it is worth while going ahead with it. Now can that money be obtained in any other way than by asking people to put their money into it. I think it is most reprehensible that the mining interests of our country should be endangered as they are in some cases by fake schemes being put upon the market, and money being put into them by persons who can ill afford to lose it; but that there are many sound mining enterprises, hundreds, even thousands of sound propositions throughout the Dominion no man will deny. Now then we must get down to business, and the only way we can do it is to make our criminal law as stringent in regard to putting these schemes on the market as you would with respect to a man picking your pocket, or cutting your throat, and then when you get laws into that condition, enforce them. They will never be enforced unless the honest common sense of the people engaged in mining schemes will take the matter up and enforce it themselves. The mine is there and it develops into a sort of gambling scheme. There is a jack-pot there—I do not know what the term means, Mr. Chairman—and they chip in and hope to rake off that jack-pot. There must be more or less of that at the outset, but I think there is a time in the history of a mine when it ceases to be a gambling speculation and comes to be a business proposition, and if the mining people themselves will discountenance on every occasion all schemes that have not got a mine at the back of them we will get down to the position in which they are in California at present, down to a business basis. I believe they have got down to that in Nova Scotia and Quebec ; I do not know whether we have in Ontario, but I hope we will get that far very soon. I believe we have a large amount of mineral wealth, and the only people we have to fear are those who live so far away from us that we cannot watch them, but still there are a great many honest people amongst them. You can treat the investor in mining property as if he were a child, and protect and surround him with all sorts of safeguards, but that is too much paternal government to suit me. A man goes into a speculation with his eyes open, and if he puts his money into shares that do not represent the mine he ought to be in the same position as any other greenhorn who gambles.

In my short experience, I find that a great many people listen to you carefully and attentively, and you think you are going to do business with them, but they shake their heads, and the first thing you know they have gone into some other scheme. If a man chooses to buy a pound of tea because it is cheap there should be no law to say that he should not buy a cheap pound of tea because it is cheap. This is the first meeting that I have attended, and I do not know whether these papers are intended to provoke discussion. I am not in the position to discuss this paper as I would like, and I should certainly like to have been the gentleman who wrote the paper, because I would be in a better position to defend it than to attack it. I may tell you, Mr.

Chairman, that I came to this meeting to learn, and I hope I may be able to learn something before I go away.

Mr. A. Dick.—Mr. Chairman, I have recently come from British Columbia, and as Mr. White mentioned Ontario and left British Columbia out it might be assumed of course that British Columbia had a monopoly of this wild-cat industry. Now, speaking for myself and my friends who are here, I am quite sure that all mining men in British Columbia are quite willing that all safeguards should be thrown about investors in the east, and that, in the interests of these mining men as well as investors, all these fake schemes should be exposed. But I think on the other hand we are apt to unduly magnify the numbers of these fake schemes, and we should be very careful in making statements in our own papers, especially as foreign papers might be very apt to assume that there were very few honest mining enterprises being worked in British Columbia. The Mining and Engineering Journal took for granted the large production of South Africa, West Australia and the United States, but it was very particular to add that an increase was expected in British Columbia, but they had better be careful as there was a dangerous breed of wild-cats springing up in that country. I think that we should endeavor to show our friends in foreign countries, the United States, etc., that there are a great many mines which are likely to prove very productive and very profitable.

Mr. White, Q.C.—I certainly hope that I did not say anything which would convey to my friends in British Columbia the idea that they had the monopoly of wild-cat schemes. On the contrary, from all I can hear they have very good mines there, and I have met a gentleman from British Columbia who was an honest man investing his own money in his own mine.

Mr. J. Bawden then moved, seconded by Mr. John Hardman, "That this Federated Mining Institute declares that the amendment of the law relating to the incorporation of mining companies throughout the Dominion demands the early attention of the Dominion and Provincial Legislatures for the purpose of securing as much uniformity as may be practically attainable, for affording increased protection of the rights of shareholders, and for promoting the financial integrity and safety of mining enterprises operated by joint stock companies; that the following gentlemen be a committee on legislation to submit to the Dominion and Provincial Legislatures such amendments to the law as may appear suitable to promote these objects; Dr. Porter, Dr. Goodwin, W. R. White, Q.C.; Mr. John Hardman, S.B.M.E.; Mr. B. T. A. Bell, Mr. F. A. Heinze and the mover."

Mr. White, Q.C.—I think, Mr. Chairman, that this is a resolution that ought to pass. It can certainly do no harm whatever, and I think it would do a great deal of good. My view in regard to it is that there is very great reason why all the laws of the different provinces should be assimilated. As I understand, we do not propose to mine "Provincially" but "Dominionally." While, however, these laws are under the Provincial jurisdiction they might be assimilated. The development companies, such as in South Africa, might be able to work in different provinces. It would give them a very much larger scope, and we would get a very much larger amount of capital in our mining enterprises.

The motion was carried.

The Responsibilities of the Mining Engineer.

By Dr. J. B. Porter, Montreal.

I have been asked to talk this evening on a subject of very great importance, and one which we, as an association, have every interest in bringing to the attention, not only of the young men entering our profession, but of the public as well. I question the probability of finding in any society a higher average of personal or professional integrity than in an association such as this one of mining engineers; but although this is a great deal to say, it seems to me that it applies to us as individuals rather than as a society. We should be able to say still more. Other bodies of professional men, as for example, the physicians and civil engineers have set up for themselves ethical codes; and by so doing have put at least a check to the operations of the incompetent and unscrupulous men, who, unfit and unable to become members of these societies, have, nevertheless, used the name of engineer or physician as a cloak under which they have covered their own operations.

The time may never come for us, as mining engineers, to set up any code different from that governing all self-respecting professional bodies; nevertheless—and unfortunately—the business of mining offers more temptations to the unscrupulous man than almost any other, and I think it behooves us, as the body most likely to be affected, to do what we can to put the work, not only of ourselves but of the profession at large, on the highest possible plane.

And while in one sense it may seem almost impertinent for me—a new comer—to address you as I shall this evening—to call attention to duties which no doubt you appreciate as well as I, and to say words of warning which might be better and more authoritatively put by many of our old members, in another sense, it is perhaps not inappropriate. As a new comer, I hope I may be excusable in pleading ignorance of local conditions and of local prejudices, if such exist. At the same time, I trust that the position I have the honor to hold in our great university here, and the amazing kindness and cordiality of the people in this city, have already quite removed me from the ranks of the outsiders.

I have been here less than six months, and when I look at the magnificent beginnings of the establishment in which I hope before long to be at work and see nothing but bare walls and unfurnished spaces, the promise of great usefulness but the accomplishment as yet of nothing, when I see this I feel that I am indeed a new comer, and so far as you are concerned unknown. The moment, however, that I turn to the people about me, all this feeling of newness goes. I have been here not six months, but double that many years. My friends could scarcely be more numerous nor more helpful had we been associated since childhood, and I feel that I really am what I hope you will consider me—one of you.

Let me then talk freely, for I promise to be brief, on a subject of the very grevest importance to us—The Responsibility of the Mining Engineer.

A few years ago there was a spirited discussion, I had almost said, row, among my confreres over in the States, about the value of the mining engineer from a commercial standpoint. Let us begin by looking at this side of the matter, although it is far from the most important.

At first sight the returns of the U.S. Census of 1890 seem to show that the mining engineers of that country are a most insignificant body of men. I can't say how many engineers there are, civil, mechanical or electrical, to each man who even poses on the returns as one of our craft As we get deeper into the thing, however, we take heart. Although so few in numbers, we find that the enterprises which we control play no small part in the financial affairs of the country, and when the figures are finally cast up it becomes evident that for each mining engineer in service there are added not less than $100,000 yearly to the earnings of the nation. On the supposition that the average engineer remains in practice for twenty-five years, this means that a man in our profession controls and superintends during his life, operations which yield between two and three million dollars gross revenue.

These figures are of course merely approximate, and have even been questioned by some; but the most severe criticism still leaves it evident that the mining men play a greater part than their brother engineers, no one group of which can show even one-half of the above average figures, even by the most partial methods of calculation.

Furthermore, the work of the miner has one great distinction over most other commercial enterprises. He does not merely divert wealth from some distant channel to that one in which he is interested, but he actually creates wealth, by bringing into use material which otherwise would remain inert and worthless.

If therefore the work of our profession is of such great importance to the community, we should be the more careful that it should be not merely as good as other people's work, but really above reproach.

The case is even stronger than this, however. In many branches of engineering, the engineer, while he has great responsibility, is in a sense working in plain sight and with plain facts. Unless he be dishonest or utterly incompetent, he is carried along by his work and his facts to what is, approximately at least, the proper solution of the problem at hand. With the mining engineer, on the contrary, the case is different. The whole question of ore deposits is one of uncertainty. The science is as yet in its infancy, and at best can never be made the subject of exact laws like those of most other matters considered by engineering. Therefore the mining engineer deals not with certainties or calculable probabilities, but with indefinite probabilities or even improbabilities.

In mining the possibilities are immense—almost fabulous—but to balance this the chances of failure are correspondingly great. I refer of course to legitimate and honest effort; alas! the opportunities for fraud are also very great, and although fortunately the pay of dishonesty is usually low, yet it is not always so, and I am certain that there are few among those of us who have begun to grow gray who have not to confess, at least to ourselves, that it has been hard to withstand the temptation of some particularly "good thing."

If the line of demarcation between what is right for us and what is wrong were the comparatively plain one between honest work, and self-evident scoundrelism, with an accompanying risk of an exposure in the courts, the case would be different, and I should talk of something else, for it is scarcely my intention to discuss the advisability of keeping clear of the prisons. It is, however, very different. As I have already pointed out, there are important branches of mining in which the game is at best one of probability, and often of mere chance; and it is a curious fact that a chance is a most fascinating thing, and often more tempting to us than a certainty. When this chance, as in mining more than in any other venture, is for some very great prize, our judgment —already struggling against our gambling instinct—is doubly taxed.

I am sure that older members of the profession here will agree with me, that for every mining engineer who deliberately does the wrong thing or makes a purposely false report, there are twenty—nay, fifty—who are more tempted by this wonderful thing—Chance;—in other words, by their own hopes, by the enthusiasm of the people about them, mine owners, the very miners themselves, and so are lead—without the least conscious dishonesty—to write too favorable a report, to advise an extravagant purchaser, or to continue work where plain hard common sense and good engineering would commend a more conservative course, or perhaps abandonment of the enterprise.

It is against this kind of dishonesty—for it is nothing less—that I think we should make an aggressive fight. At this moment there are many young men preparing to go—as some no doubt will soon do from my own lecture-room—from the steady conservatism of this settled matter-of-fact world of home, college and business, to the golden west and north—the lands of great expectations—of sudden and great success—and also of many and bitter disappointments.

Let us speak most forcibly to such men, but also if it must be, to some who are older in the profession, and perhaps even we may be the better off if we heed our own words.

Let us remember that the profession requires more than the mere honesty and personal integrity that every right minded man must have. It requires of the engineer intelligent and painstaking personal study of each case brought to him, watchfulness against fraud on the part of others, and the innocent, but no less dangerous enthusiasm of friends and workpeople; watchfulness indeed even against his own hope and enthusiasm, or perchance against his equally excessive dread of failure; and after he has thus come at his facts, he must study the chances, weigh them as fairly as possible, and come to a decision not only as regards what is apparently certain, but also as to what are the possibilities of greater success, and the prospects of corresponding disappointment. If he makes his report, advises his manager, or runs his own mine, if manager on such a basis as this he will be doing his best. If he does less, he will fall short of the highest standard of worth and integrity, which the true mining engineer should strive for.

Some will say to this that if every miner followed so dreadfully conscientious a method some of the greatest mines of the world would never have been discovered. I question it, although no doubt the discoveries would have come later, and often have been better used. But even granting the truth of the statement and waiving the unanswerable argument that "right is right, and that our knowledge and ability are given us to be honestly used," still I think it easy to prove, that for every dollar lost or rather unfound by intelligent conservatism, there have been twentyfold losses through extravagance, through hopeless efforts of suguine ignorance, and, worst of all, through the dishonest use made by engineers and experts, who themselves were not dishonest, but just a little too hopeful or too easily misled.

And in closing I must speak briefly of this last mentioned thing—the false prospectus and its use in securing the money of people, who are those usually least likely to be able to spare it.

In times of mining excitement like the present, along with the notices of genuine discoveries and developments, the newspapers are full of lying statements, and there are hosts of sharks about, ranging in size from the great promoter from London or New York to the petty pedler of shares in some backwoods district; each with specimens of ores, glowing prospectus, reports and all the paraphernalia of the trade.

We engineers cannot of course undertake the Herculean task of putting down or even denouncing all of these frauds, but I do think that many of us, and perhaps the Society as a unit, falls short of its real duty. Some of us know of reports—perhaps our own—that are being used in a different sense from that in which they were intended; still more frequently, we chance to know positively that the stories of this or that district or mine are absolutely false, yet, as we are not concerned, we let the lie do its work unchecked.

If instead of this, we co-operate with some of the journals which at present wage an almost single-handed war on this sort of fraud, and in all other ways practicable strive, both as a society and as individuals, to put the mining business on the best possible basis, we should do much for the credit of our profession, and more for our country at large; and perhaps by some happy law of compensation, the money thus saved from the sharks might in part at least go to some honest mines employing us at munificent salaries.

The Question of Initial Payments on Bonds.

By Howard West, A.R.S.M., New Denver, B.C.

A considerable time spent in the heart of the great Kootenay country, during which in my professional capacity I have been brought into close connection with both the capitalist and the prospector, has convinced me that the above question has become one of more than passing importance, and that in fact it plays, and is destined to play still more, a no inconsiderable part in the development of regions now perhaps unprospected for lack of proper communication, but which are known to be exceedingly rich in mineral deposits, and must eventually succumb to the rapid advancement now being made in all directions.

It is very obvious that the higher the percentage of investors who lose money by embarking in mining ventures here, the lower the reputation of the province will become as a medium for safe and systematic investment. As this is of all things what we wish to avoid most at the present time, when not only British and American capital is being turned this way, but Canadians themselves are displaying unwonted interest and activity in our mineral resources, it is distinctly advisable for us to try and discover if possible a means of developing them to the best advantage, with the least possible risk to the investor. In this connection there are two courses which immediately commend themselves to all thoroughly practical mining men. The first of these is what is known as the working bond; the holder in this case guarantees to do a stipulated amount of work on the property in a given length of time, at the expiration of which he decides definitely whether he will take it at the price previously agreed upon, or relinquish all right in that direction. This is now becoming quite a common procedure in the Slocan and elsewhere, and while under certain conditions it presents undisputed advantages, it compares favorably with other methods now in vogue.

The other general arrangement referred to, which slightly modified appears in a variety of forms, is that whereby the discoverer and original owner receives payment in direct proportion to the value of his find. This is readily accomplished in more ways than one; by disposing of a portion of the property for a sum to be spent in development estimated to be sufficient to place it in a paying condition, either to a private individual or a company; or it can also be done by leasing the claim to responsible parties, who agree to pay a regular percentage of the value of the output, whatever it may be, for the privilege of working it. This to me seems about as fair a proceeding as can ordinarily be devised for the benefit of indigent prospectors, the only difficulty arising in fixing the exact percentage to be paid, which must, of course, accommodate itself to the varying conditions inherent in different properties. If the mine can be worked at a profit, this arrangement when properly carried out is clearly to the interest of both parties. These important phases of the bonding questien are undoubtedly deserving of the most earnest consideration at our hands, but in this paper it is found utterly impossible to cover the entire ground, so for the rest I shall confine myself to the subject mentioned in the title, namely—initial payments.

In the ordinary method of bonding as accepted almost universally in the west, it is customary to divide the total consideration into two or more payments, usually the latter, which become due as different stages of development are reached; and here I wish to remark that from personal experience I have no hesitation whatever in saying that in many parts of the country obstinacy regarding the exact terms of these preliminary payments has caused more deals to fall through than all other causes combined, although I do not wish to disguise the fact that exorbitant valuations have also much to answer for in that direction.

To those but superficially acquainted with western mining ways, and the economics of mining in these regions, this may seem to be at first sight an etxtravagantly broad statement, and in view of the large number of properties which are bonded on the regular plan without inconvenience to either contracting parties, contrary to general experience and entirely unsupported by fact; but to those whose daily avocation brings them into more intimate relation with those people, the conviction is forced upon them that the question is assuming serious dimensions in certain parts of Kootenay, and it is no exaggeration to say that in consequence of this attitude, many who would willingly assist in developing our mines refuse to do so. Should they invest on this basis, and in addition to the actual money spent in proving what they never owed, a large part payment be also lost, they will in all probability go away with the determination to leave mining severely alone in the future.

The main question then which we wish to discuss may be briefly stated as follows : Is it right or reasonable on the part of the owner of a mineral claim under bond to expect an initial payment before the bonder has had any opportunity of proving its value ?

The prospector says that it is ; the investor, with interests in this case diametrically opposite, that it is not ; with, of course, the usual exceptions on either side ; so that it merely remains for us to consider the matter in detail impartially from both standpoints.

There are naturally two sides to every question. We will begin, therefore, by noting carefully the contentions already advanced by the prospector in support of the principle of initial payments.

He argues that he spends time, trouble and experience in searching for mineral claims which may ultimately prove of value, and thus help indirectly to enrich the province and all connected with it. Considering the arduous and intermittent nature of his occupation, and the uncertainty of adequate remuneration attending his efforts in this direction, I suppose there is nobody so uncharitable as to grudge him the full measure of such success as may result from his undertakings. Supposing now that having staked his property he is fortunate enough to bond it for say $50,000 ; the surface showing would evidenily indicate that it was worth in all probability at least that sum, and possibly a great deal more. If in the course of development it should prove to be worth *ten* times that amount, he has no hold whatever on the property, and will consequently receive only a fraction of the true value of his find. Should the prospect on the other hand turn out to be valueless, the person holding the bond will lose the amount of money which he has expended in development only, assuming that no initial payment has been made. The prospector then stakes the possibility of his property eventually turning out to be more valuable than he anticipated, against the amount of development work done, which the bonder stands to lose. In his opinion the odds are not equal, and to compensate him for the advantage which he considers the bonder has, he insists on a percentage down before any development is attempted.

The fallacy of the main point in this argument is seen when we observe that the initial payment is not required to be anything additional or supplementary; it merely forms part of the total consideration, and should the claim prove to be of value, the owner receives actually no more than he otherwise would, saving a trifle in interest, which for all practical purposes may be ignored; failing which, he obtains that to which he has no title or right.

To put it concisely then, the initial payment clause only becomes effective at the very time when it should not; that is to say when the claim has proven itself unworthy of further expenditure upon it.

Inquiries are frequently made by claim owners regarding the manner in which they are expected to live while their properties are being exploited by others, unless they are paid something in advance. This of course admits of various replies. I presume ordinarily in the same way that they would gain a livlihood if the claim were never bonded at all, but as a matter of fact in the majority of instances the person bonding the claim is only too glad to take advantage of their local knowledge and assistance during development, and pay them well for their services.

If the prospector had always to deal with honest or true capitalists intent on working the properties themselves, the main problem would be much simplified; but as it is, they can here advance the strongest and most effective argument in support of their demands.

Too many of those who pose as men of means or representatives of capital are the most ignoble scoundrels—regular wolves in sheeps' clothing—whose sole aim is to gain an option on a good property from some unsuspecting and too confiding prospector, not be it understood with the object of working it or ultimately taking up the bond, but intending to transfer the option to someone else for a higher figure, without ever having invested a single cent in the undertaking. In the event of failure to interest others in the venture the prospector has his property tied up, and entirely beyond his control for probably the best months in the year, which means to him a serious loss that he can ill afford. Nobody in their senses will blame him for trying to protect his interests by demanding an initial payment under such conditions. It is a lamentable fact that he is unable to distinguish the man who means well, from the imposter whose every act should be made to betray his identity, because in this way those who approach him with the intention of acting fairly and conscientiously have to suffer for the sins of the scheming fraternity.

So far as the true capitalist is concerned, it is readily apparent that in the majority of cases the prospector possesses that which in its present condition is to him entirely valueless for all practical purposes. He can do nothing without the assistance of capital, and having obtained that it is clearly evident that the man with the money is the only one who stands to lose materially should the property not turn out satisfactorily. This being the condition of affairs, it cannot surely be right to impose an additional burden upon the shoulders of those to whom we look with confidence for the necessary assistance in opening up our latent resources. Any such attempt must inevitably react upon those who conceive the idea, and tend to drive elsewhere those whose consideration and attention we have been striving so assiduously to obtain in the past.

Let it be understood that in this paper I make no attempt to explain the principles governing the entire bonding system. Such a task would be prodigious in its magnitude, and take up more time than is at my disposal. No fixed method of procedure can be laid down as applicable to all cases; circumstances invariably differ, and in every instance it is necessary that the wording of the bond be carefully adapted to the special conditions connected with the particular mine or claim; but the disastrous effects of the present methods are constantly being brought under my notice, and while I think the principle of initial payments is a decidedly pernicious one, and unwarrantable where the true capitalist is concerned, it is manifestly due to the prospector to explain the difficulties under which he labors, in trying to avoid the advances of those whose presence may become a menace to the speedy and effective development of the country.

Advantages of Compressed Air.

By James F. Lewis, Chicago.

The first recorded experiments in compressing air were made by Hero of Alexandria, who flourished 150 years B.C. Papin in the seventeenth century investigated the subject to some extent, and according to Ganot's physics the air pump was invented 1650 by Otto Guerick.

In 1726, 1753 and 1757, patents were taken out for different methods in compressing air. From 1810 to 1860 quite a number of patents were issued along this line, but the first work of any moment done by compressed air was in 1861, driving the Mt. Cenis tunnel. The honor of first applying successfully to any great extent compressed air for the purpose of driving rock drills in America belongs to one of your prominent and highly respected citizens—Mr. Walter Shanly, when he was driving the Hoosic tunnel, from December, 1868, to December, 1874. This tunnel is 24,100 feet long; 361,500 cubic yards of rock excavated; 544,735 pounds nitro-glycerine and mica powder burned. Mr. Shanly in that early day found great saving in cost over hand labor, as well as time in completing his work.

It was in this tunnel also that nitro-glycerine was first introduced into this country. Therefore Mr. Shanly has the honor of being the first to make a success of the three great powers that have been instrumental not only in developing the great mining industries of this country—sinking to great depth for the precious metals—but making it possible to carry out wonderful engineering projects—driving tunnels and excavating canals from one to thirty-four miles long,—air compressors, rock drills and high explosives. We might say that these three powers have revolutionized the world. I would call to your minds the excavating of Flood Rock in the East River, N.Y. In this work 21,669 feet of tunnel were driven, 80,232 cubic yards of rock excavated, and about 480,000 pounds of high explosive consumed

After this ground had been taken out, 12,561 holes or 113,102 feet of borings were made in the roof and top of pillars, in order to blow them down. These holes were filled with 240,399 pounds of rackarock powder and 42,331 pounds of dynamite, or a total of 282,730 pounds of high explosive, costing $106,509.93. The total amount of rock broken by the final blast was 270,717 cubic yards, making a total of 350,949 cubic yards of rock excavated from under the East River, requiring 762,730 pounds ot explosives—about 2.17 pounds to the cubic yard of rock.

The driving of the N. Y. aqueduct tunnel, 34 miles long, 14 to 16 feet diameter, excavated through 32 shafts from 60 to 387 feet deep. Time required, about five years.

The Chicago drainage canal, 28 miles long, with 14 miles of rock sections, 160 feet wide, 35 feet deep, 14 dirt or glacial drift sections 210 feet wide at bottom, 350 feet wide at top. Total excavation of rock 12,343,316 cubic yards, 28,059,488 cubic yards of glacial drift.

Also copper mining in Lake Superior, where from 1881 to 1887, inclusive, were mined 467,459,465 pounds of copper from shafts 3,000 feet deep; from 1888 to 1897, nine years, they have taken out 999,854,186 pounds.

One of these mines, the Atlantic, pays good dividends with rock carrying only ·64 of 1 per cent of copper.

The mining industries of Quebec, copper, mica, asbestos, and the nickel and copper mining of Ontario, the gold mining of Nova Scotia, and the extensive coal mines of Cape Breton—coal being taken out from under the sea so cheaply that they are able to ship it to the States. Also British Columbia, where a great many towns are being built, and large dividends paid monthly from precious metals taken from the bowels of the earth.

These and many other large industries have been made possible by the use of compressed air.

The largest compressed air plant in the country is at Quinnsec Falls, on the Monomonee River, the falls being 47 feet in height, and furnishing unlimited power, which has been harnassed by modern skill to do economic duty.

This plant consists of three pairs of Rand air compressors, 32 in. diameter by 60 in. stroke, and one pair 36 in. diameter by 60 in. stroke, delivering 3,000 h.p. through 3½ miles of pipe to the Chapin and Lodington Iron Mines, at Iron Mountain, for pumping, hoisting and motive power engines above ground, and direct acting pumps and rock drills below ground. This power is carried through a 24-inch pipe with a loss of only one pound in pressure, and the superintendent figures that he gets an efficiency of 75 per cent.

The second largest plant is at the Calumet and Hecla Copper Mines. They have three pairs of compressors, 28 in. diameter by 48 in. stroke, 32 in. diameter by 48 in. stroke, 36 in. diameter by 60 in. stroke, respectively. During the first craze for electricity, this company refitted their mines with electric power. After working it two or three years they became convinced that it was costing them much more money than when they used compressed air, therefore, the electrical machinery was discarded and they returned to the use of air.

Corliss Compressor as used.

Until quite recently the mine owner has taken no thought as to the economy or efficiency in compressed air, feeling that it was a necessity and caring little about the cost, so long as it enabled him to prosecute his work, but during the past three or four years there has been a great change in this respect. The mining engineer has been looking carefully into the question of economy, and the manufacturers find with pleasure that they are willing to pay for the highest type of air compressors. The same may be said also of contractors. They are fast becoming educated by experience to the fact that there can be a great saving made by using the most economical machinery for their work.

The Chicago drainage canal has been a great educator in this respect. It was a long time before the contractors on that work could be convinced that it was economy to use compressed air as a power on open work as against steam. Finally, however, Messrs. Mason, Hoge, King & Co., and E. D. Smith & Co., were persuaded to purchase compressed air plants, but before they could be installed the work had been prosecuted for six months by the use of a number of small steam plants scattered over the mile sections. The air plants were installed in the centre of the section, and the air carried in pipes along the banks of the excavation, and after working six months with compressed air, they were fully convinced that it was at least 20 per cent. cheaper than the use of steam for the same work. Therefore, ten rock sections out of fourteen were worked with compressed air. The other four with steam, and from data thus obtained it shows conclusively that air was the most economical. The cost of drilling with steam was 8.64c. per cubic yard of rock, with air 6.30c. per cubic yard of rock.

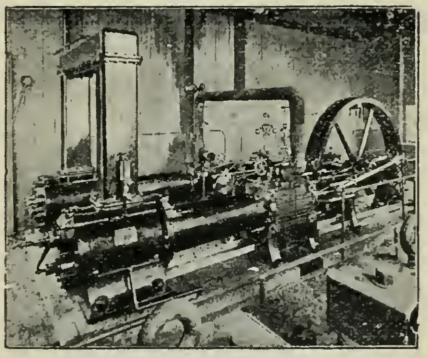
Two of the contractors had the courage to purchase a high type of air compressor, and the saving in the coal pile was greatly to their advantage, and very soon paid for the extra cost of the compressors.

Messrs. E. D. Smith & Co., who excavated two miles of the Chicago drainage canal, are now driving a two-mile tunnel near Boston. From the experience they had in the canal, they equipped the two miles of tunnel with two first-class Rand-Corliss engine air compressors, both of them duplex machines, 20 in. diameter cylinders, 36 in. stroke. The plant is installed at one end of the tunnel, the air carried the two miles through pipes, and the entire work of pumping, hoisting and drilling is done by compressed air.

The same company is also doing a large piece of work at Niagara Falls, excavating for the new wheel pits, which are to be 185 feet deep, 20 feet wide, 180 feet long. The entire work of drilling and channeling is being done with compressed air.

Great progress has been made during the past four or five years with compressed air as a power in mechanics. In fact it is fast becoming universal for use in machine shops, boiler shops, foundries, railway shops, bicycle shops, and also for deep well pumping.

There is yet much scepticism as to its economy or efficiency for mechanical purposes, but a great change of opinion has and is taking place among many of our most thoughtful mechanical engineers. They are becoming converted rapidly in favor of compressed air. They find no end to its uses after it is once introduced into the shop or foundry. The advantages of it as a motive power in shops are numerous. It is easy to handle; it is clean and neat; it is always ready to do its work the moment the throttle is opened; it can be carried from one end of the shop or yard without loss, if properly piped.



High Class Air Compressor.

It has been considered until quite recently rather an expensive power, because railway shops have labored under the same impression as mining men, that any old cylinder or machine was good enough to make compressed air. For instance, you will find railway shops using five or six locomotive pumps that produce from 50 to 60 cubic feet of free air per minute. This means an investment of $600 or $700 tied up on the wall.

With an air compressor that would not cost over $500 they can produce double this quantity of air with one-fifth the amount of steam. Many railway shops are being fitted up with the most economical air compressors, and mechanics are becoming ready to testify to its efficiency and great saving over other powers.

Four or five years ago the Messrs. Cramps installed a large economical air compressor in their shipyard, piping the air throughout their works. They say to day that it has been one of the greatest money saving machines they ever purchased.

About a year and a half ago the Atchison, Topeka & Sante Fe Railway installed a duplex Rand 20 x 48 air compressor in their shops at Topeka. They have now about five miles of air pipe running through their shops and yards.

Since then they have purchased eight compressors for their different line shops.

It may be interesting for you to know what their master mechanic says regarding the saving over the old way, by using the Baird Portable Machine Co's tools, run by compressed air. Of course, this saving is figured on the basis of the tools working steadily through the day;

" With the 10 foot reach stationary riveting machine you can drive 2,000 rivets per day of 10 hours, with three laborers, at a total cost of $4.75 per day. This compared with hand labor, three men, total $7 per day, will drive 200 rivets.

The 6 ft. riveter, combination flange punch and riveting machine, and the bridge and girder riveter, will each average about the same as the 10 ft. reach riveter.

The truck riveters, one machine operated by two laborers, total $3 per day, drives 3,000 rivets in a day of 10 hours. As compared with hand labor, three men at $6 of a total, in the same class of work, will only drive 175 rivets.

The frame riveter will average about the same as the truck riveter.

The stay bolt breaker will make an average saving of $8 a day.

The tank riveter will make an average saving of $10 a day.

The mud-ring riveter will drive as many rivets as can be handed to it, and will make a saving of from $12 to $15 a day for that class of work. Not only does it make a great saving, but it ensures every rivet hole being entirely filled, and insures tight work, while with hand-driven rivets in mud-rings a large per cent. of them invariably leak and have to be caulked or fullered up.

The stay-bolt cutter will do the work of 15 men. This machine will very easily cut off 1,500 bolts an hour, while when cutting off by the old method of hand, hammer and chisel, you must agree it goes very slow, and it is hard work.

The rotary tapping and drilling machine will do the work of four men.

The rotary grinder saves the work of six men.

Compressors for A., T. & S. F. Ry.

Rotary saw, for sawing car roofs, saves the work of four men.

Pneumatic hammer will save the work of three men.

Crown-bar bolt machine saves the work of three lathes.

Rail saw saves the work of two men.

Rail drill saves the work of two men.

Device for operating transfer table saves $6 per day.

Device for revolving driving wheels for setting valves saves the labor of two men.

Device for shearing bolts saves the labor of two men.

Thirty hoists in shops saves the labor of ten men at $1.50 per day.

Device for loading and unloading oil at storehouse saves $6 per day over the old method.

Jack for pulling down car draft sills saves $10 per day.

Device for fitting up hose couplings over the old method saves $15 per day.

Pneumatic painting machine, one man does the work of ten using a hand brush.

Machine for tearing down old car roofs saves $8 per day.

Jack for raising and lowering freight and passenger cars makes an average saving of three men.

Drop pit makes an average saving of three men.

Device for sanding engines saves one man.

Shifter for switching cars in shop yard saves $50 per week.

Device for cleaning coaches saves 10 men.

Device for rolling flues makes a saving of two men over the old method.

Whitewashing, when in use, will do the work of ten men with a brush."

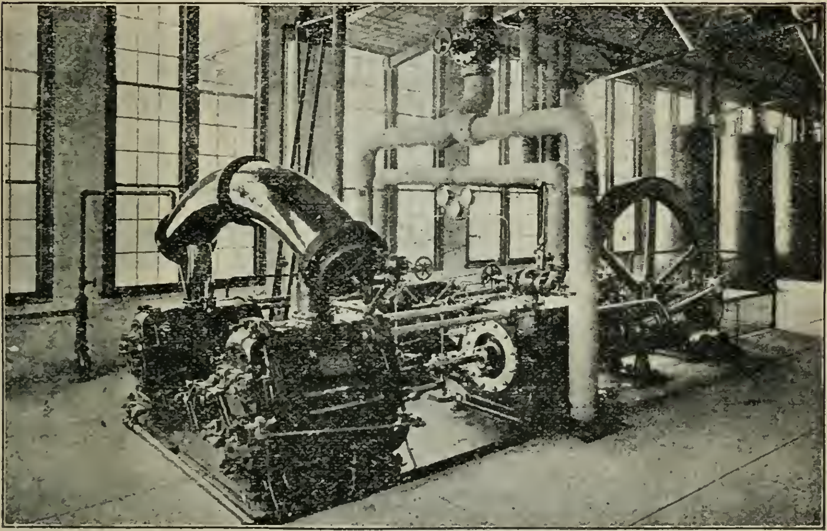
Mr. J. H. McConnell, Superintendent of motive power of the Union Pacific Railway, furnished the following interesting and reliable figures, showing what can be done by the use of compressed air in shops. He says :—

"The many savings through the use of air in shops of the Union Pacific system aggregate $10,000 per year in labor alone.

SAVINGS PER DAY.

Putting wheels in wheel lathe, three lathes in the shop, an average of one change a day, saves one man in handling this work … … … … … … … … … …	$1 60
Hoisting steel tired wheels and axles in lathe, an average of six changes a day, saves one hour in time, 20 cents, and one man less to handle the work, $1.60 … … … …	1 80
Hoisting axles into cut-off lathe, an average of ten changes a day, saves one hour per day in time … … … …	25

One large boring mill, averages two changes a day, $1.60, saving of time of 30 minutes, and the use of one helper, 25 cents … … … … … … … … … … …	1 85
Handling cylinders in large boring mill and planer, saves the labor of one man and one-half hour each change … …	1 60
Three men working on pistons, etc., in raising them from the floor to the bench, serving three machinists, saves one helper a day … … … … … … … … …	85
Raising chucks, face plates and other heavy work, air hoists in the machine shop, saves one helper a day … … …	1 50



Illinois Central Railway Compressor.

Lifting driving wheels and other heavy work on the large slotting machine, saves the time of one man and 20 minutes	1 50
In applying cylinders on boilers, saves one machinist and helper's time of ten hours … … … … … …	2 40
Facing valves, saves helper's time of four hours … … …	60
Pressing on driving wheels and axles, three less helpers, one hour each … … … … … … … … … …	45

Boring out cylinders, three helpers time, four hours	1 80
Applying driving brakes to old engines, drilling holes, reaming. etc., saving 15 hours time of machinist and helper ...	6 70

Pneumatic tin and galvanized iron press, in getting out stock for 20 dozen water buckets, get it out in eight hours, where it previously took 40 hours.

In making brake shoes, stamping a loup to have casting run on, previously one man would do 200 in a day, where he now does 600. All work of this machine saves in the neighborhood of from 50 to 60 per cent.

Running foundry elevator with the air hoist saves 25 per cent. of one man's time.

Saves 75 per cent. time putting in stay-bolts in a fire box by using air motor for tapping out holes and screwing in bolts.

Saves in the neighborhood of 50 per cent. in using pneumatic hammers for caulking both flues and boilers.

Take engines in and out of round house when necessary to change them, saves the work of six men, pinching, possibly 45 minutes, not counting the delay of the men waiting to go back to work on the engine.

Blowing out engine with air, saves a cord of wood, besides the inconvenience and delay, as the men cannot work around a hot engine to advantage.

Handle all engines on the transfer tables, now run by air, previously run by crank. One man does now what six did before; where six men move a foot in a minute, air motor under like conditions will move 12 feet. As this is moved several times a day this is in itself a great saving.

Pneumatic hoist for unloading scrap at the foundry. The old method took six men ten hours, under the same conditions with the hoist two men will do it in four hours.

Cleaning a car by air saves ten per cent. in time.

Unloading a car of wheels it takes six men half an hour, now three will do it in 15 minutes.

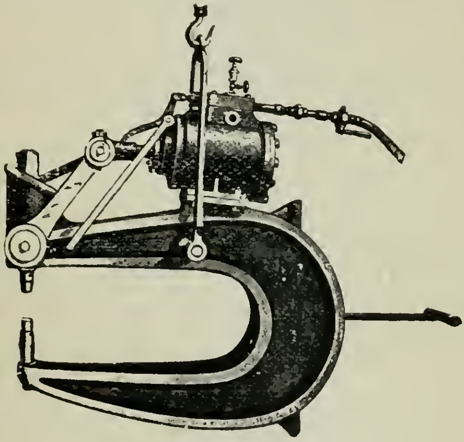
Air jacks for raising and lowering freight cars now take one man three minutes where previously it took two men ten minutes.

Truck jacks to remove three pairs of wheels take 1½ hours, the old method took six hours.

Sandpapering off a 50 ft. baggage car by hand took in the neighborhood of 60 hours, now it takes 14 hours with the sandpapering machine.

Air whitewashing machine, where it took ten men five days it now takes four men one day, and a 75 per cent. better job.

New applications of compressed air are made daily, two of the most recent being an air motor attached to a differential hoist, and a portable stay-bolt cutter that can be operated in the hands of one man, thus doing away with the cumbersome affair hung on a post."



Geo. D. Brooke, master mechanic of the St. Paul & Duluth R.R., says:—

"We are rapidly increasing the use of the air in the shape of hoists, air boring machines, air bull-dozer for blacksmith shop, air flue welder, and 4-in. cylinder air hammer for light forgings and drawing out the ends of driving and truck springs. It is giving perfect satisfaction, and will soon pay for itself in the item of saving in laboring help, independent of shortening the time of work."

He also sends the following data of a test of Rand Air Compressors, 7½ x 14 in. diameter x 16 in. stroke air cylinders, with 10 x 16 duplex steam cylinders:—

"Steam pressure, 70 pounds.

Air pressure, 110 pounds.

Revolutions per minute, 35.

Temperature of cooling water, 55 Fr.

Temperature of discharge water from cylinder jackets and intercooler, 62 Fr.

Temperature of engine room, 80 Fr.

Temperature of cold air inlet, 70 Fr.

Temperature of discharge air from low pressure cylinder, 170 Fr.

Temperature of air entering high pressure cylinder, 65 Fr.

Temperature of discharge air from high pressure cylinder, 135 Fr.

AVERAGE FROM A NUMBER OF INDICATOR CARDS.

Two steam cylinders 10 x 16 in., initial pressure 54 pounds, M. E.P. 40 4 pounds, I. H.P. 17·95 pounds.

Low pressure air cylinder, 14 x 16 in., M.E.P. 21·3 pounds, I. H.P. 9·24 pounds.

High pressure air cylinder, 7½ x 16 in., M.E.P. 21·3, 46·0 pounds, I.H.P. 5·75 lbs.

Both air cylinders (high pressure reduced to low) M.E.P. 34·5, I.H.P. 14·99.

Friction of compressor 16·4 per cent., I.H P. 2·96 pounds.

Steam per I.H.P. per hour, 29·33 pounds.

Cubic feet of free air compressed to 110 pounds pressure per pound of steam at 54 pounds initial pressure, 10·6 pounds.

Efficiency of air cylinders, 91·5 per cent.

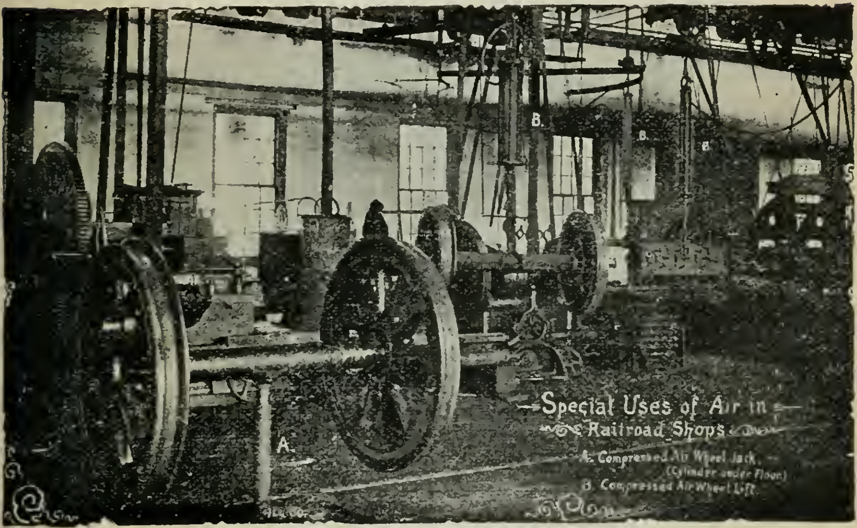
The apparent large loss due to friction of machine was entirely brought about by the machine being new and stiff, and the slow speed which we ran it governed by the air consumption."

Mr. F. L. Wanklyn, master mechanic of the Grand Trunk Railway system, has been greatly interested in the use of compressed air for a long time, and has made it quite a study so far as he could with the machine that the company was willing to give him, which consists of an old engine taken out of the scrap heap, to which he fitted an air cylinder. He is using air for the following work, and says :—

" The uses to be found for compressed air seem to be inexhaustible as far as a machine shop is concerned, as hardly a day passes without some suggestion being made for a new and advantageous application of this handy and expeditious system of transmitting power.

1st. For hoisting.

2nd. For running small reciprocating engines and rotary motors for drilling and tapping, especially in connection with stay-bolting of fire-boxes, also for facing valve-seats and re-boring cylinders.


Special Uses of Air in Railroad Shops
A. Compressed Air Wheel Jack, (Cylinder under Floor)
B. Compressed Air Wheel Lift.

3rd. For breaking stay-bolts when removing old inside fire-boxes.

4th. For cutting off projecting ends of new stay-bolts prior to riveting.

5th. For chipping and caulking, and driving and snapping tank rivets.

6th. For whitewashing.

7th. For operating moulding machines.

8th. For testing air-brake apparatus, and blowing through air and steam pipes.

9th. For supplying necessary blast in connection with oil-glass furnaces for setting and removing tires

10th. For supplying blast to riveting fires in portable forges.

11th. For operating cinder hoist in connection with round-house ash-pit.

12th. For operating small pneumatic jacks to take the place of the holder up in riveting over fire-box stay bolts."

In a discussion on the advantages of compressed air at a meeting of the Western Railway Club, Mr. E. M. Herr, then Assistant Superintendent of Motive Power of the Chicago & Northwestern Railway, now Superintendent of Motive Power of the Northern Pacific Railway, says :—

" Compressed air is advantageous about a railroad shop for another reason, in this it differs from electricity and has an advantage over it, that is that when the storage is not being drawn upon the plant can be shut down absolutely, and still the reservoir with the power is at hand at all times for use. This is of great advantage in a place where but a small amount of compressed air is used, and used occasionally. For instance, at night it might be very advantageous to have compressed air at hand for use at intervals, when a compressor that would probably work an hour or an hour and a-half at night, would compress all the air that was necessary. This being stored in the reservoirs can be drawn upon, and the compressor would automatically shut down when the desired pressure was obtained."

There has been but very little data accumulated from actual practice regarding the cost of making compressed air. We have the following from the A. T. & S. F. Railway shops at Topeka :—

" Steam pressure, 80 pounds.

Air pressure, 100 pounds.

Tons of coal of 2,000 pounds, per month, 155.

Cost of coal per month, $139.50.

Cost of coal per ton, 90c.

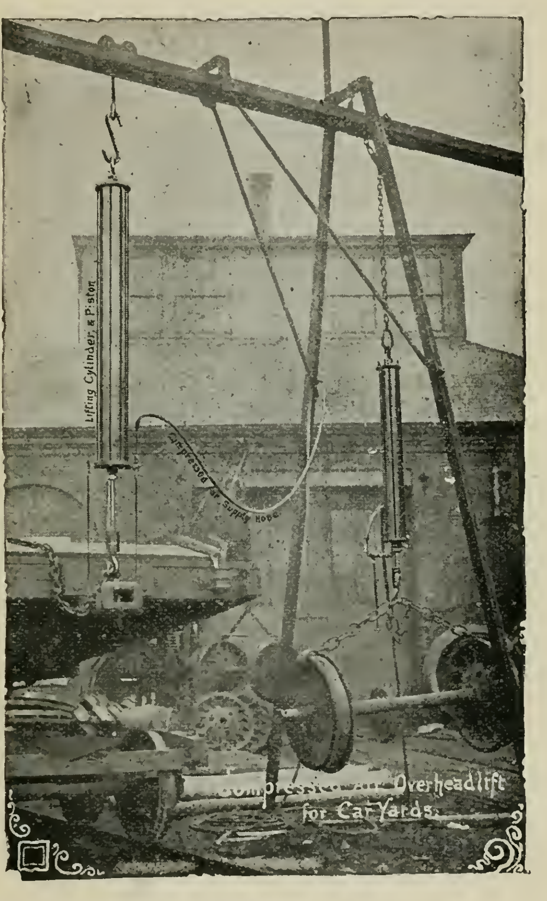
Amount of free air per minute, 1,712 cubic feet.

Amount of free air per day of ten hours, 1,027,584 cubic feet.

Amount of free air per month of 31 days, 31,855,104 cubic feet.

Revolutions per minute, 50.

Pounds of coal per 1,000 feet of free air, 9.7.


Lifting Cylinder & Piston
Compressed Air Supply Hose
Compressed Air Overhead lift
for Car Yards.

Cost per 1,000 feet of free air, .00437c.

The above compressor is fitted with Meyer adjustable steam valve, compound air cylinders with mechanical air valves on low pressure cylinders. Air is taken from outside the engine room.

The above cost is for air delivered from the compressor for fuel only, that is, the cost of oil, labor and interest on cost of plant not considered.

Steam cylinders 20 x 48 in., air cylinders 28 x 16 x 48 in., H P. 310. .

Mr. Wm. Forsyth, of the C.B. & Q. R.R, says regarding the case of compressed air :—

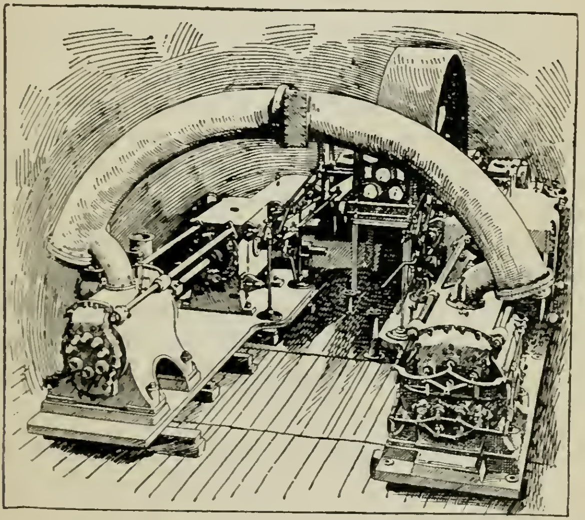
" We have indicated the engine with the air compressor free, and also when it was compressing air to 80 lbs., and found that it required 40 H.P. We get a horse-power with a Corliss engine with 4½ pounds of coal per hour, and the air compressed consumes 204 pounds of coal per hour, and at $3 a ton the cost of a thousand cubic feet of free air compressed to 80 pounds is 10c. With coal at $1.50 per ton, it is of course only 5c. per 1,000 cubic feet.

Mr. W. Renshaw, Superintendent of Motive Power and Machinery of the Illinois Central R.R. Co., says :—

" We installed at our Burnside shops, about a year ago, a Rand Duplex Corliss Air Compressor, with compound air cylinders, and at present are using compressed air for the following purposes: Elevating sand at engine house, elevating oil at oil house, hoisting heavy castings and parts at machine tools, etc., forcing couplings on air hose, operating cylinder boring bar, operating valve facing machine, filling cylinders of hydraulic presses, removing and applying driving tiers, testing water pumps after repairs, drilling with motor, tapping with motor, reaming with motor, cleaning boilers, cleaning machinery, punching jacket rivet holes, taking old paint off tin roofs, rolling and beading flues, chipping, cutting, caulking small bull-dozer, elevating water from deep wells, testing air and driver brakes, elevators in storehouse, operating letter presses, cutting out stay-bolt stubs, jacking up cars and trucks, cleaning interior of coaches, cleaning upholstered work, burning paint off coaches, painting cars, sand-blast ends of cars. gasoline heater, cutting off stay-bolts, screwing in stay-bolts, rivet forges, one blacksmith forge, pressing in driving-box brasses, operating flange clamp, swedging flues.

This is the list to date, but we are finding further use of the compressed air every day, and we could not afford to be without it.

I consider it the best means of transmitting power in and about shops. 1st. On account of the many uses to which it is adapted, and the simple appliances needed in connection with its use. 2nd. With but few exceptions in the above list, steam and electricity could not perform the work without more complicated apparatus, and in a great many instances air alone is applicable. 3rd. Most of the appliances used are of our own manufacture, and in connection with the pipe line are easily kept in repair by our own shop men. 4th. There is no element of danger, and the apparatus requires no skilled mechanic to handle same, and it is safe to use in places where steam or electricity might be objectionable. 5th. It can be carried greater distances without loss than steam, and taking into consideration cost of plant, cost of maintenance, skilled help required, etc., it can be produced for less money than electricity.



As regards saving made over old methods, would say, taking into consideration all things, that an average all-round saving of from 25 to 30 per cent. could easily be realized.

Take, for instance, the saving effected by use of air hoists alone, which, though hard to figure, will assume large proportions when the amount of labor they take the place of is taken into consideration.

We figure a saving of 66 per cent. in burning paint off passenger cars, and 50 per cent. in painting freight cars and passenger trucks."

This compressor is a duplex, with steam cylinders 20 in. diameter x 30 in. stroke, fitted with improved Corliss valve gear. The air cylinders are compound, 26 x 30 low pressure air cylinder, 15 x 30 high pressure air cylinder, having an intercooler which carries the air from the low-pressure cylinder to the high pressure, through pipes that are surrounded by water, thus cooling the air after the first compression before it goes into the second compression cylinder.

The intake cylinder has a hooded head, arranged so as to take the air from the outside of the building. Whenever required it gives them the air compressed to 150 pounds, with steam pressure at 80 ponnds.

The same type of compressor is used by the St. Paul & Duluth Railway Co., also Atchison, Topeka and Sante Fe Railway Co., also the Michigan Central R.R. at St. Thomas.

In a paper read before the Western Foundrymen's Association, by Mr Geo. A. True :—

" Taking a basis of 2,000 ton-feet per day, assuming the operators' labor at $2 per day, we have an operating or attending labor of about 25c. per 1,000 ton-feet. The total cost, therefore, of hoisting one ton 1,000 feet will be about 32c., or in a foundry of 30 tons daily capacity about 65c. per day, using direct acting vertical hoists, or roughly, in a 30 ton per day foundry, $5 per day represents the labor of hoisting by hand power against 65c. per day by air hoists, a saving well worth considering.

Making a comparison with hand power, as already stated, the cost of hoisting by manual labor in the foundry under consideration would be not far from $5 per day, equivalent in good times to $1,500 per year. By air it would cost $200 per year, or, if we include interest on the investment, which is only fair, we will have a hoisting cost, when operated by hand-power of about $1,600 against $380 using air. The saving would go far towards purchasing a first-class air plant."

Messrs. The Massey-Harris Co., of Toronto, Ont., say :—

"We are using the air compressor in connection with burning oil fuel in our smith shop. We have for some years been using oil for fuel instead of coal. Last week the writer spent some hours in the factory of Wm. Deering & Co., Chicago, where they are using compressed air for hoisting cranes, which seems to work very nicely indeed. The heavy flasks in the moulding shop and the molten iron are lifted by these pneumatic hoists as well as the heavier castings in the machine shop. They are also to a limited extent using it for ramming the sand into the moulds, etc. We have no doubt it will be used to a very much greater extent in the near future than it has been in the past. So far as using it in connection with oil fires is concerned, we may say that after some six years' experience with oil we would not go back to coal under any consideration."

Air is being used very extensively for pumping deep wells, taking the place of the old style deep well steam pump, and in every case it increases the output of the wells from 25 to 75 per cent.

In a recent 24 hour test, pumping four St. Peter wells, the following data were gathered :—

"Wells about 400 ft. deep. Water standing to within about 6 ft. of the top when not being pumped. When being pumped the water fell to about 84 ft. Wells were cased with 6¾ in. I. D. casing. Air pipe one and a half inches. During the twenty-four hours there were delivered 2,016,678 gallons water, lifting it about 96 ft. There was an average delivery of 11.15 gallons of water per H.P.

Cards were taken from the steam and air end of the compressor each hour. Average H.P. of steam cylinders, 125.6. Average H.P. of air cylinders, 116.14, showing a mechanical efficiency of about 92 per cent., or about 8 per cent. of friction."

We also have the following data taken from one month's report in pumping water from three deep wells :

"Steam pressure, 80 lbs.

Air pressure, 68 lbs.

Tons of coal of 2,000 lbs. per month, 106¾

Cost of coal per month, $167.60.

Cost of coal per ton, $1.57.

Amount of free air per minute, 352.8 c. ft.

Amount of free air per day of 24 hours, 508,032 c. ft.

Amount of free air per month, 15,748,992 c. ft.

Revolutions per minute, 45.

Pounds of coal per 1,000 ft. of free air, 13.5.

Cost per 1,000 ft. of free air, .0106c.

Amount of water pumped, 76,255,000 gallons.

Cost per 1,000 gals., .002c.

The above compressor is fitted with Meyer adjustable steam valves, 14 in. in diameter x 22 in. stroke, air cylinders simple, 14 in. x 22 in., fitted with mechanical air valves, air taken from outside of engine room. The above cost is for the air delivered from the compressor for fuel only, that is, the cost of oil, labor and interest on plant not considered. H.P., 51.

The U.S. government made very exhaustive tests before adopting compressed air for the navy. They have recently purchased air compressors for use on board ship, compressing the air to 600 lbs., with 80 lbs. of steam pressure.

Air is used on board ship for the following purposes :

To operate ; Main engine auxiliaries ; auxiliary, fire, bilge and water service pumps ; steering engine ; anchor engine ; boat cranes ; winches ; turret-turning engines ; hydraulic cylinders for working guns ; ammunition hoists ; ash hydro-pneumatic hoists ; feed pumps ; smoke hose for guns ; whistle and siren ; also to send messages about the ship ; to clear a compartment of water when filled ; to ventilate ; to heat and cool the ship. The ordinary working launch is run by compressed air. There are also many other uses to which it can be applied on shipboard.

They have also purchassed several compressors for their dynamite guns, using the air at 1,700 lbs. pressure, with 50 lbs. steam.

The efficiency of compressed air is greatly increased by re-heating before it enters the working cylinder. This has been demonsttated by experiments in our shops. Also practically demonstrated in Paris, where air is carried about the city for power purposes by what is known as the Popp System. They claim an efficiency of 92 per cent. by re-heating the air, as against 70 per cent. not heated.

During an experiment by the writer in running street cars by compressed air, it was found that the cars could be run 8 to 10 miles when the air was re-heated before entering the cylinder, and only 4 to 5 miles with cold air. The air was carried in storage tanks at from 600 to 800 lbs. pressure, being passed through water heated to 360 degrees, to a reducing valve, and used in the cylinders at from 50 to 150 lbs. pressure, according to the grades or condition of the track. This was known as the Mekarski System, which has been used successfully in Nantes for the last eight or nine years, and three years ago three street car lines were established in Paris under the same system. They carry the air at a pressure of between 1,100 and 1,200 lbs., reducing it to the proper pressure when used.

During the experiment in this country, the cars were run about 40,000 miles, fully demonstrating that compressed air is practical, economical and most delightful for street car propulsion.

Compressed air as a power has certainly proven itself worthy of consideration, and to be produced economically it should be treated on the same basis that a mechanical engineer would treat the question of economy in a steam plant. I am happy to say that there have been rapid strides in this direction during the last two years.

There is no question but what compressed air can be produced and utilized with as much economy and as great efficiency as any other power, by simply putting in economical machinery for producing it.

A Description of the 150 Horse Power Hydraulic Air Compressor erected for the Dominion Cotton Mills Co., at Magog, Que.

By C. H. Taylor, M.E., Montreal.

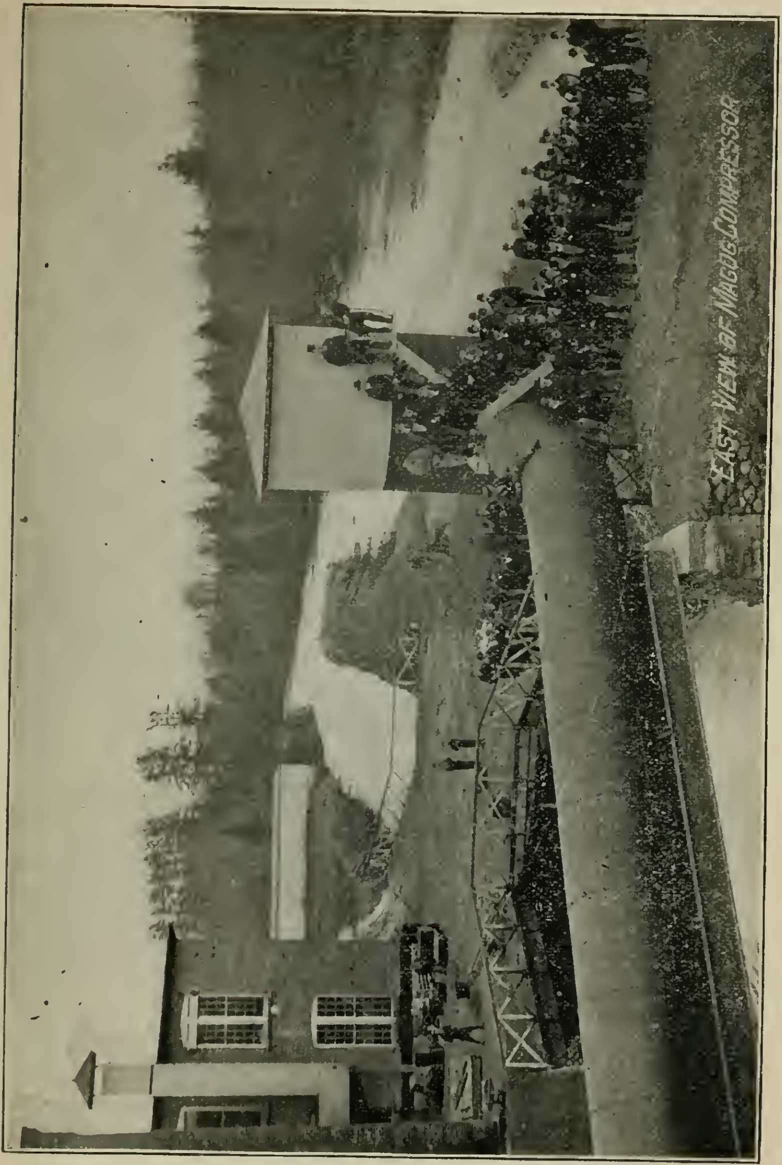
The construction of the plant consists in sinking a shaft to the necessary depth and erecting the separating tank, compressing pipe, headpiece with the air inlets and penstock.

The shaft of the Magog plant has been sunk to a depth of 128 feet. The dimensions inside the timbering and rock are 6 feet by 10 feet from the top of the shaft to within 16 feet of the bottom, where it is enlarged to 20 feet in diameter. The timber used in the shaft is 8 in. x 8 in. hemlock, and sets being placed 4 feet apart, centre to centre. The timbering extends from a point 3 feet below low water level in the tail race down a depth of 72 feet, of which the last 20 feet is in the rock. All the timber above the rock is backed with 2 in. hemlock plant. As each set was put in, each plank was wedged separately, and the space filled up solidly with fine gravel. After timbering was completed, a lining of 2 in. hemlock plank was put in. The space between this lining and the rock was filled with concrete, thus forming a solid base upon which the upper timbers were supported. This careful timbering was necessary because of the nature of the ground, which is composed of layers of running sand. The rock below the timbering consists of a very fine slate. A mud seam an inch and a half thick cuts the shaft at the bottom of the timbering, separating the solid rock from rock of a loose nature above.

On three sides of the mouth of the shaft a stone wall has been laid in Portland cement. This wall is 3 feet thick at its base and batters upwards to 2 feet at the top. Its height is 14 feet. It has for its foundation two layers of 10 in. x 12 in. timbers laid crosswise, bedded in cement, with 10 in. spaces between the timbers filled with concrete. The space between the walls, forming the tail race, is 13 feet. The timber in the structure will always remain below water level, consequently it will be of as permanent a character as the remainder of the plant.

The material of the compressor is ¼ in. steel plate. A penstock of 5 feet 6 in. diameter and 160 feet long conveys the water from the canal, or forebay, to the receiving tank at the head of the compressor. This tank is 12 feet in diameter and 12 feet high open at the top, and rests upon four 12 in. L-beams spanning the foundation walls. The compressing pipe, 44½ in. in diameter, passes through the center of the bottom of this tank and projects 3 feet up into it. A 10 foot telescoping pipe is inserted into the upper end of the compressing pipe. On the upper end of this is rivetted a cast iron bell mouth piece, 4 feet 8 inches in diameter, which is part of the head piece. Three lugs are on this casting by which the upper part of the head piece is attached to the telescoping pipe. The upper part of the head piece is a casting in the form of a cylinder 4 feet 8 inches diameter, terminated below by a conoid, of which the surface is concave. Three 1¼ in. bolts attach the lugs on the bell mouth piece and telescoping pipe to three corresponding lugs on the cylindrical piece above. Two flanges, 6 feet 2 inches diameter, encircle the cylindrical part of the casting above and below, which serve to hold vertically in place thirty 4-foot lengths of 2 in. wrought iron pipe equally distributed around the cylindrical casting. The lower ends of these pipes are flatly welded together. Near the lower extremity of each pipe five rows of holes are bored to receive thirty-three ⅜ in. pipes all within 15 in. of the closed end. In each of these holes a pipe 6 in. long is screwed and bent so that they are all directed towards the centre of the compressing pipe. These pipes serve to admit the air and direct it into the water. The combined head piece and telescoping pipe are supported by a 2½ in. square threaded screw, which passes through a timber spanning the top of the tank. A hand wheel with nut attached supports the screw and enables the head piece to be raised or lowered as desired. As before mentioned, the compressing pipe starts from a point 3 feet above the bottom of the upper tank and extends down the shaft. Its total length is 136 feet. Its diameter is uniform for 116 feet, but it enlarges in the last twenty feet from 44½ in. to 56 in. diameter.

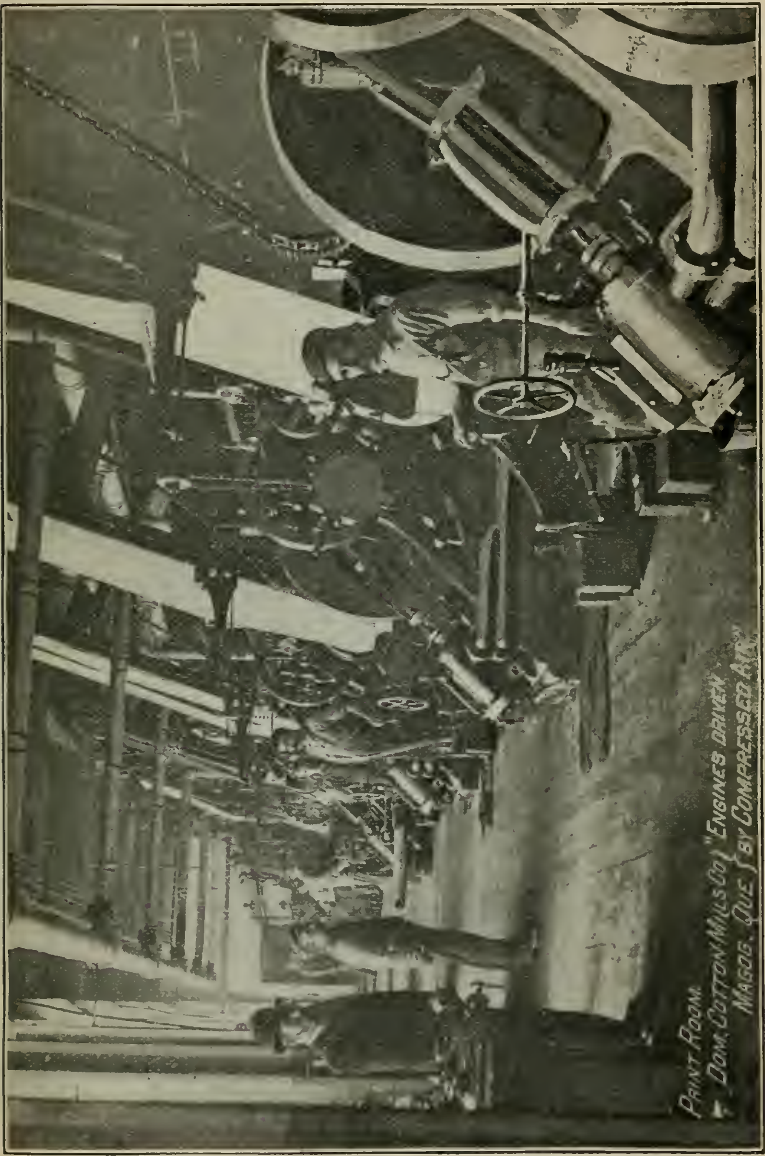
This compressing pipe is constructed with butt joints held together by 4 in. straps rivetted to the sections. All the rivet holes are counter sunk, thus making a perfectly smooth interior. The lower or separating tank is 17 feet in diameter and 12 feet high. The bottom of this tank is open and rests upon eight cast iron legs, which raise it 16 in. above the bottom of the shaft. The top or cover is conical, rising two feet to where it is connected with the compressing pipe. The compressing pipe extends down into the tank 9 feet below the cover, its lower extremity being 8 feet from the bottom of the shaft. Directly under the compressing pipe is placed a circular casting, the upper surface of which is a conoid similar to the one already mentioned in the head piece. Its diameter is enlarged by steel plates to 12 feet. The opening between this disperser and the lower end of the compressing pipe is 14 in. The disperser is supported on a pedestal, and also strengthened by stays from the compressing pipe. Fourteen inches below the outer edge of the disperser is a conical apron 5 feet wide extending around, and rivetted to the interior of the separating tank. Both this apron and the disperser have two 5 in. pipes 5 feet long, extending upwards to allow the escape of air, which collects underneath them, to the main body of air in the upper part of the tank. A 4 in. waste pipe, or "blow-off," begins on a level with the lower end of the compressing pipe, and close to it. On this end is an elbow and short piece of pipe, the latter having its upper half removed. On each side of this elbow and pipe a plate 18 in. x 20 in. is bolted to the pipe, leaving the top and one end open. The waste pipe passes through the top of the separating tank, extends up the shaft to a point 10 feet above water level, and is terminated by a return bend for the purpose of directing the spray and water into the tail race. Opening out of the top of the separating tank is a 7 in. pipe to conduct away the compressed air. This main extends up the shaft and is carried into the mill. After it enters the mill a self-acting regulating valve (of which a sketch is shown), is placed for the purpose of preventing the water from entering the air pipe, should the supply in the separating tank fall short at any time of the demand. As the air fills the separating tank the pressure increases by a few pounds. When the pres-


EAST VIEW OF MAGOG COMPRESSOR

sure lessens to a certain degree by the rise of the water, the valve closes automatically before the water can reach to within 15 inches of the top of the separating tank, and thus adjusts itself to the supply of air from the compressor. From this valve a 6 in. pipe is carried to seven pairs of 8 in. x 12 in. engines, also to two singeing machines, a 9 in. x 12 in. single engine, and two Worthington pumps. A 1 in. steam radiating pipe passes through a portion of the air pipe, and raises the temperature of the air to about 150 Fahr.

In the working of the compressor the water is carried through the penstock to the upper tank, which it fills to about the same level as the fore bay. From thence it enters the opening between the two castings of the head piece, passing among and in the same direction as the small air pipes. The water creates a partial vacuum at the end of these small pipes, so that the atmospheric pressure drives the air into the water in innumerable small bubbles, which are carried with the water down the compressing pipe. In their downward course the bubbles are compressed according to the depth and weight of return water sustained. When they reach the disperser their direction of motion is changed from the vertical to the horizontal. The disperser directs the mixed water and air towards the circumference of the tank. Its direction is again changed towards the centre by the apron, from whence it is again returned towards circumference of the tank. During this process of travel the air has been separating by rising in the tank and also under the disperser and apron. The water (almost free of air in this plant), escapes under the lower edge of the separating tank and returning up the shaft surrounding the compressing pipe, is carried off in the tail race. The air rising through the water to the top of the separating tank, displaces the water and is kept under nearly uniform pressure by the weight of the return water. The variation in pressure does not exceed three pounds per square inch.

The air bubbles are comparatively small; they are surrounded by a cold body of water, and compression takes place through the whole length of the compressing pipe. From this it will be readily inferred that this mode of compression is isothermal, a process which is not accomplished by any other compressor. More energy is consumed in



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DOM. COTTON MILLS CO. "ENGINES DRIVEN
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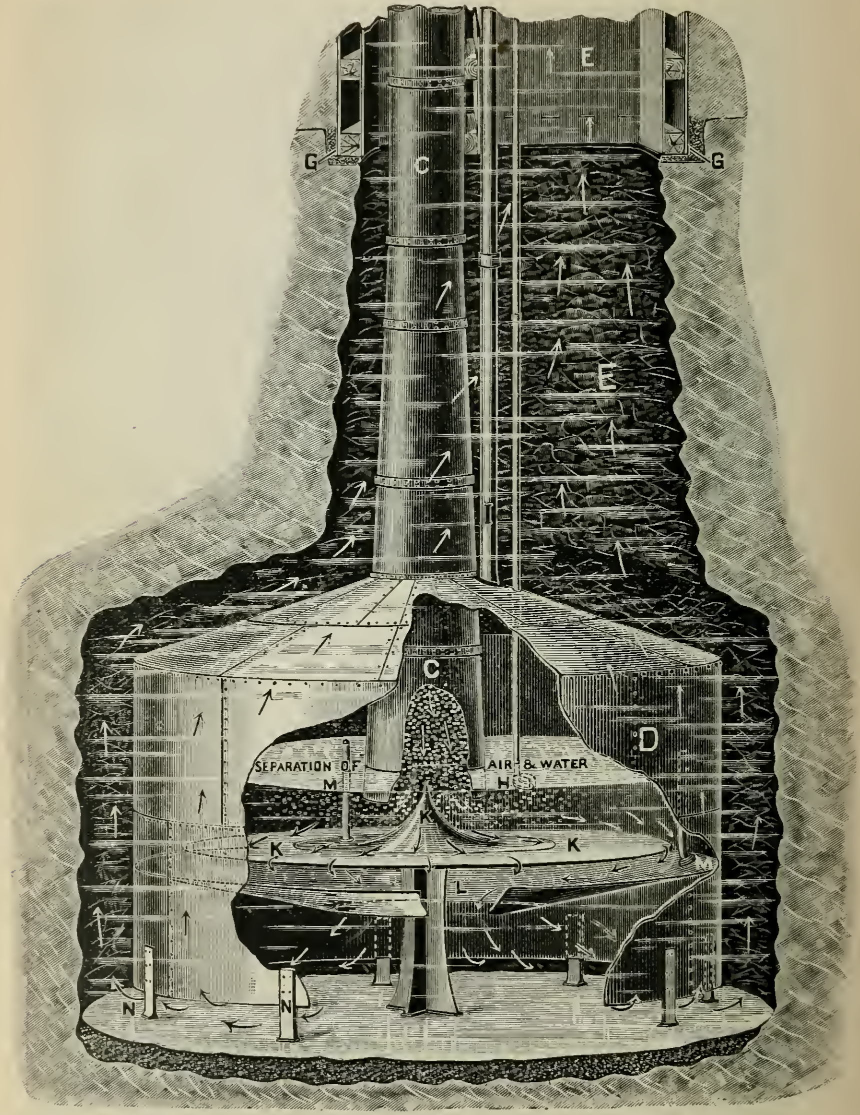
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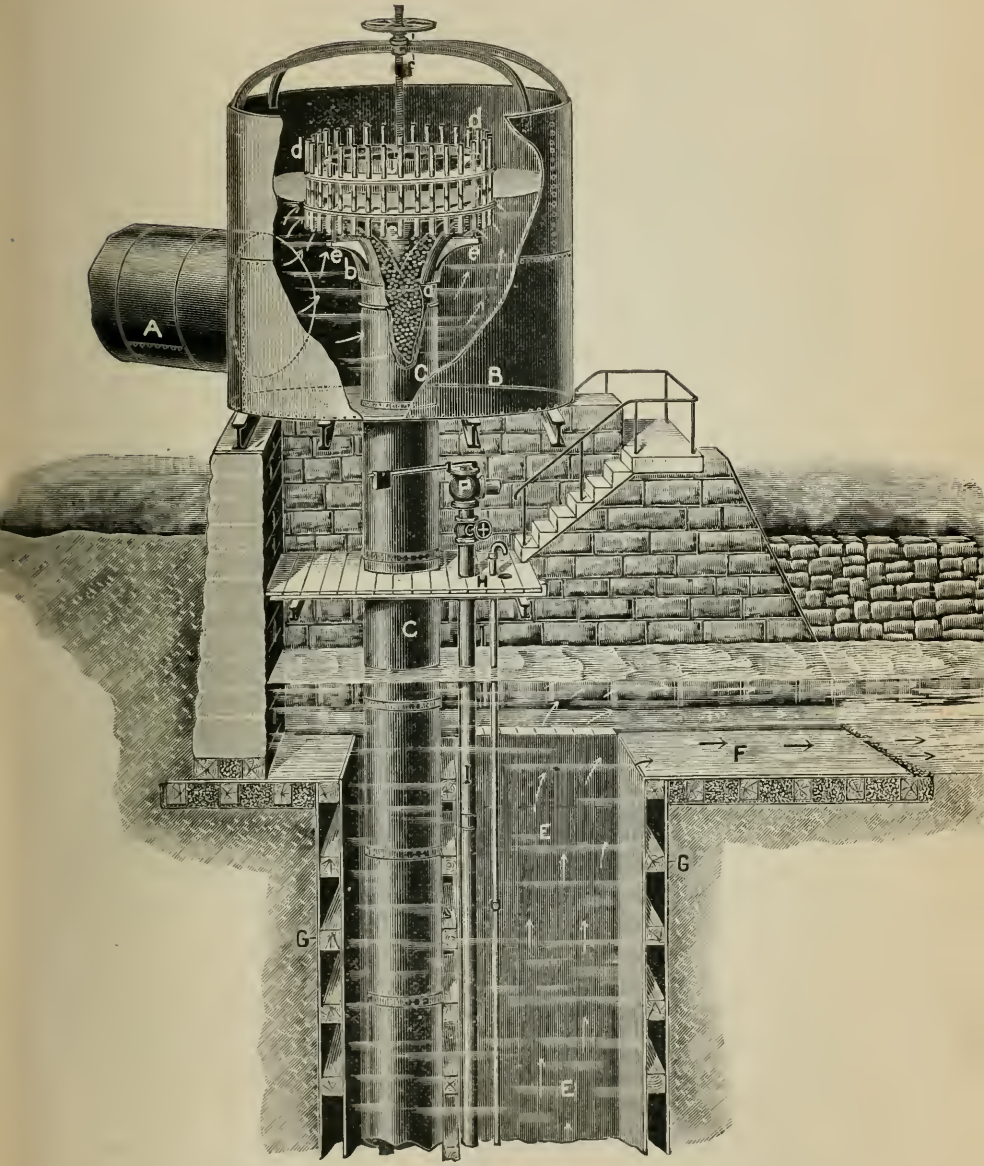
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compressing a body of air adiabatically than in compressing it isothermally. The rise in temperature acquired by air compressed adiabatically is generally lost in transmission. Hence by this system of compression a considerable saving of energy is effected. It is a well known fact that a given space will hold a weight of water vapor greater or less according as the temperature is high or low. If at any given temperature a space is saturated with vapor, when the vapor is compressed isothermally into smaller space a portion of it will be condensed. Where air is compressed mechanically it is heated, and the water vapor contained is not condensed because of the rise in temperature. When, however, the air passes through the cool transmission pipe condensation takes place. Should condensation not occur in the transmission pipe on account of insufficient cooling, it takes place at the exhaust of the motor because of the great fall in temperature due to the work done by the expanding air; thereby filling the exhaust with ice. Where compression of air is effected by water, as in the system considered in this paper, condensation takes place on the walls of the bubble, and so can neither take place in the transmission pipe, nor at the exhaust, even when the temperature is very low. The compressed air delivered is of the same temperature as the water compressing it, and in the Magog plant its volume is about 2-9 of that at atmospheric pressure. Hence the air after its expansion in the motor will not contain sufficient vapor to saturate it at even the greatly reduced temperature.

By a test made on 50 cubic feet of air delivered by the compressor while in full operation, it was ascertained that the air when expanded to atmospheric pressure contained 1-5 of the amount of vapor usually found in the atmosphere during fine weather, or about 14 per cent. of saturation.

On the proposal of this method many engineers and others raised the objection that the air bubbles, after being carried down 34 ft. (the height giving a pressure equal to that of the atmosphere), would separate out by their buoyancy and fall no further. They thus predicted as a limit of pressure attainable about 30 lbs. absolute.

Others predicted that the cold air entering and being diffused through the water would congeal the same. Others again promised us an efficiency of not more than ten per cent., from experience obtained about 200 years ago with the trompe used in the south of Spain.

I am pleased to say, however, that none of these predictions have been fulfilled.

In the maiden plant at Magog we have actually obtained an efficiency of over sixty-two per cent., and this was obtained in spite of the fact that we are wasting, owing to the insufficient size of the air chamber, about twenty per cent. of the air compressed.

This defect, which can be easily remedied in future plants, is accountable for a loss of about 15 per cent. in efficiency. So that it is safe to guarantee an efficiency of 75 per cent. as easily attainable in future installations.

The annexed table takes the results of a series of tests made on the Magog compressor by Prof C. H. McLeod, of McGill University. The first three tests were made on the 7th of August, and the last three were made on the 13th of August, 1896.

Column two gives the quantity of water in cubic feet per minute flowing through the compressor; column three the available head in feet during the trial. Column four gives the gross horse power in the fall under these conditions of flow. The fifth column gives the measured quantity of air discharged at atmospheric pressure, the actual pressure being given in the sixth column. The horse power required to compress this quantity of air to the pressure in column six is given in the seventh column. The ratio of the horse power in column seven to that of column four is called the efficiency, and is given in column eight. Columns nine, ten and eleven give the temperatures of the air, water and compressed air.

Results of Trials of the Taylor Hydraulic Air Compressor at Magog, P.Q., on August 7th and 19th, 1896.

No. of Trial.	Quantity of Water Discharged in Cubic Feet per Minute.	Available Head in Feet.	Available Horse Power.	Quantity of Air Delivered in Cubic Feet per Minute at Atmospheric Pressure.	Pressure of Air in Compressor.	Actual Horse Power of Compressor.	Efficiency of Compressor.	Temperatures.		
								External Air.	Water.	Compressed Air.
I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.
1	6,122	21.4	247.7	1,377	52	132.5	53.5	79	75.2	75.2
2	5,504	21.9	228.0	1,363	52	131.0	57.5	83	75.5	75.5
3	4,005	22.3	168.9	1,095	52	105.3	62.4	80	75.6	75.6
4	7,662	21.1	305.9	1,616	52	155.4	50.8	75	80.0	80.0
5	6,312	21.7	260.0	1,506	52	144.8	55.7	77	80.0	80.0
6	7,494	21.2	299.8	1,560	52	150.2	50.1	75	80.0	80.0

From observations made in glass tubes, the rate of rise of the air bubbles due to their buoyancy is from 5 to 7 inches per second. To illustrate the effect of this slip take a 75 lb. pressure installation requiring a depth of 173 feet from tail water to separating chamber. The velocity of the water in the compressing pipe would be about 12 feet per second, so that the compression would be effected in 14.4 seconds. During this time the bubbles would have risen but 7 ft. 2 in., a comparatively unimportant loss; which is still more lessened when we bear in mind the fact that the volume of air is on the average one-fifth of that of the water descending with it.

Regarding the freezing of the water by the entering air, it is only necessary to point out that the lowering of the temperature of 1 cubic foot of water from 34 to 33 F. would raise the temperature of 277 cubic feet of air at atmospheric pressure from 30 below zero Fah. to 33 above. As the proportion of the air to water by volume is only 1 to 5, it is manifest how small the actual cooling effect must be. This takes no account of the heat given out by the air while it is being compressed.

I have prepared a sketch which may be of interest to those members who wish to look more closely into the matter of the air compression.

The relative size of the bubbles as the air they contain is compressed, during their descent of 116 feet from atmospheric pressure to a pressure of 50 lbs. per square inch, is shown diagrammatically in this. The diminution in the size of the air bubbles is seen to be quite appreciable, and their diminished size produces less retardation of the flowing water.

A large proportion of the whole power is spent in effecting the earlier part of the compression.

It is well known that as much work must be done to compress the air to about 25 lbs. as is required to complete the compression up to 75 lbs. Hence the advantage of using high pressures.

The Gold Bearing Tailings of Nova Scotia.

By Mr. F. H. Mason, F.C.S., Halifax.

Probably in no country in the world where gold has been mined and milled for the length of time that it has been in Nova Scotia, have the tailings been so completely neglected. This is due to several causes, first among which is the fact that, although the mines of Nova Scotia have been known and worked for upwards of thirty years, no one has ever attempted to work them on a large scale. Although many of the companies operating in Nova Scotia have comparatively large tracts of land under lease, in no instance have they been opened up with a view to working them to anything like their full capacity. The largest mill in the province to-day is the 40-stamp mill at the Richardson mine in Guysborough county, while the next is the 30-stamp mill at the New Egerton mine. With regard to the latter it has not up to date been worked to anything like its full capacity, half the stamps often being idle. Besides these there are several 20, 15, 10 and 5-stamp mills in operation in the province, and in one case, that of the Blue Nose Co., operating in Goldenville, there are a 20 and a 12 stamp mill on the same property. From this it will be seen that no single mine is turning out sufficient ore to keep a chlorination plant of its own in operation. No one has shown sufficient enterprise to put up a customs plant, nor have the mine owners themselves been sufficiently energetic to combine together and put up a plant for a group of mines in one district. The Brookfield Mining Company, which owns an extensive and rich tailing dump, has recently put up a chlorination plant, but it is unfortunately situated at a considerable distance from the majority of the other mines, and consequently the cost of hauling concentrates to their works will, in most cases, be a matter of no small consideration, and will go a long way towards taking the gilt off the gingerbread, or in other words, absorbing the profits. I wish it to be distinctly understood that by the foregoing I do not desire to belittle the value of Nova Scotia as a gold field; because work in the past has been done on a very limited scale there is no reason why such should be the case in the future. There are several places in Nova Scotia where, with proper development, I have little doubt that 100 stamp mills could be kept pounding day and night on low grade ore, and show a profit on every ton of ore crushed, but up to now no one has attempted to work on such a scale. Another cause for the general neglect in the matter of tailings, is the very small capital of many of the companies operating the Nova Scotia mines, and the shareholders, who for the most part being cent wise and dollar foolish, prefer gathering in the small dividends to allowing some of them to accumulate, with a view to saving sufficient capital to put in the necessary concentrators, and thus reap a richer harvest in the end. Another reason for the neglect of tailings is the very erroneous idea which has been, and to a large extent still is prevalent in Nova Scotia, viz., that the gold in the ore in that province is all free, and that what is not saved in the battery and on the plates of a stamp mill is not worth saving. This theory has been backed by gentlemen who I venture to think should have taken the trouble to have investigated the matter a little more fully before so positively uttering such damning statements. Why Nova Scotia should stand out alone to be the one blest spot of all the gold producing countries in the world, where all the gold in the ore is free, and nothing but the stamp mill is needed to reduce it to marketable bullion, is a little difficult to see, and I should have thought that men would have investigated such a phenomena very thoroughly before declaring such to be the case. In the persuance of my profession I have probably had greater opportunities of investigating the value of the tailings from the stamp mills of Nova Scotia than anyone has ever had before. The one great difficulty in arriving at the value of such tailings, is that in many cases the samples have been taken by people unused to taking samples, and on more than one occasion, after rich returns have had to be given, I have discovered that the samples have been dug out from the dump by the end of the sluice, where a natural concentration has taken place, and a result very much higher than the truth naturally obtained. The obtaining of a true sample is probably one of the most difficult things imaginable, and cannot possibly be done by a single assay, unless it is a fluke; yet how many of our millmen imagine that they are keeping a run of gold they are losing by placing a bucket under the end of the sluice, drying the result, and dispatching it to the nearest assay office to obtain a result which is in many cases of no value to them at all.

I propose, first of all, taking the last 50 assays of tailings I have made, the maximum of which is 16 dwt., 8 grains; the minimum a trace. The average is 4 dwt., 19 grains. The methods of taking these tailings is in some cases known, and in others unknown.

I will next give the last 25 assays of concentrates I have made. I have excluded from this list three samples which I consider to be altogether abnormal, and which contained appreciable quantities of amalgam. The maximum of these is 12 ozs. 8 dwt. 6 grains, and the minimum is 2 dwt. 22 grains, the average is 3 oz. 11 dwt. Methods of taking samples mostly unknown. I now propose to select three mines as examples, namely, the Brookfield mine in the west of the province, the Central Rawdon, which is fairly central, and the Richardson, which is in the east of the province, and I may here say that I wish to thank the owners of these properties for their kindness in allowing me to use the assays I have made for them.

I will first take the Richardson mine, as in this case I took all samples myself. At the time of my visit they were in exceptionally poor ore, the return of free milling gold while I was there being 2 dwt. of gold per ton of rock crushed. The tailings from upwards of 40 assays gave an average of 1 dwt. 18 grains from one battery, and 1 dwt. 19 grains from the other, which amouuts to a loss of 46.66 per cent. of the total gold in the ore. Owing to the fine state to which the ore was being crushed, it was impossible to make a true estimate of the percentage of concentrates by panning, the only method at hand, but it approximated 4 per cent. Nearly the whole of the ore crushed could pass a 60 mesh screen, while at least 80 per cent. would pass a 100 mesh screen. A clean concentrate, panned as it came from the sluice, gave 2 oz. 14 dwt. 21 grains, and an analysis showed the mineral to be a true mispickel.

The samples from the Central Rawdon mine vary considerably, at one time running very high in concentrates. Sometimes these concentrates are rich in gold; at other times they contain comparatively small amounts. The first sample I propose giving was taken from the dump; it assayed 13 dwt. 7 grains per ton, gave 23·7 per cent. of concentrates, which had an assay value of 2 oz. 17 dwt. 4 grains. These tailings contained amalgamable gold to the value of 6 dwt. 10 grains per ton. The gangue of these tailings contains a large proportion of slate, and make a very slimy tailing; at the same time by the use of plenty of water they are easily concentrated. The concentrates are a mixture of iron pyrites and arsenical iron pyrites. It will be noticed in this case that the concentrates come out a little higher than theory, which must be accounted for by the very much larger bulk taken for the concentration test, and that their is some free gold in the tailings, and probably a little amalgam. In making the concentration test the utmost care was taken, the tailings being first sized into four lots, and each lot concentrated separately.

The next assay I propose giving from this mine gave 2 dwt. 5 grains per ton; it yielded 2·03 per cent. concentrates, having an assay value of 5 oz. 5 dwt. per ton.

Another sample of tailings from this mine yielded only a trace of gold, while the concentrates ran in the neighborhood of 10 per cent.

At the North Brookfield mine I have only records of the concentrates which average 6 oz. 8 dwt., and had the following composition:

Insoluble	13·95
Sulphur	29·21
Arsenic	16·15
Iron	34·41
Not determined and loss	8·28

These concentrates as received were somewhat oxidized. I hoped to have given some results from the practical treatment of these concentrates, but I hear from Mr. Libbey that they have not cleaned up from the chlorination works yet, at Brookfield.

I think the above results are as near the truth as it is possible to get under ordinary circumstances. It would be much more satisfactory of course if some competent person were to go round and take all the samples himself, determine the total amount of gold, the amount of free gold and the percentage of concentrates; but no one is likely to do this of their own accord, and the local government, who really in their own interest should look after this work, have either not sufficient foresight, or are more probably too busy collecting rentals and royalties, the latter being the only way they have ever attempted to encourage the gold mining industry of Nova Scotia.

A bone of contention in the past has been the condition of the gold lost in the tailings. Undoubtedly in some cases some of it should never have escaped the battery plates, but I think in the majority of cases at any rate the greater proportion of it may be looked upon as refractory gold, by which I mean in this case, gold which cannot be *economically* saved in the stamp battery.

Having, I think, clearly proved that we are losing gold in milling, the next point which naturally occurs to us is: How can we best recover this gold? One of the greatest banes to Nova Scotia in the past has been the patent process man, and I propose to throw him overboard without further comment. This brings us down to practically two processes or modifications of them, viz, chlorination and cyanidation.

With regard to the latter I have tried a considerable number of Nova Scotia concentrates by this method on a laboratory scale under the most favorable circumstances, and I have never obtained anything better than a 78 per cent. extraction, unless the concentrates were previously roasted, in which case chlorination is the better method for subsequent treatment, and although I would not condemn cyanidation in every case on this account, I think we must look to chlorination for the most satifactory means of recovering this gold.

I have in the case of both the Brookfield concentrates and the Richardson concentrates succeeded in extracting on a laboratory scale between 94 and 95 per cent. of the gold contained by barrel chlorination, and I may here say that in the case of the North Brookfield concentrates, Mr. Adolphus Thies, of North Carolina, working in a commercial way, extracted exactly the same per centage that I did in the laboratory. By leaching these same concentrates with chlorine water containing 0.7 per cent. of chlorine, I obtained over 96 per cent. of the gold contained in them, and this latter method not only has the advantage of obtaining a higher per centage than barrel chlorination, but it is also cheaper, especially in Nova Scotia, where pyrolusite for generating chlorine occurs naturally. It is now necessary for us to get some idea as to the probable cost of treatment, and I propose to take some figures given by Mr. James Douglas in a paper he read before the Society of Arts of work Mr. Thies was doing at the Haile mine in North Carolina in 1894, the following are his working expenses:

Labor	$2.31
Fuel	.55
Sulphuric acid	.24
Chloride of lime	.21
Power and administration	.12
Total	$3.43

For sulphuric acid Mr. Thies paid 1-5 cents per pound, and for chloride of lime 3 cents per pound. I have estimates for supplying those two reagents at 1-5 and 2-7 cents respectively per pound at any port on the south coast of N.S. For wood Mr. Thies gave $1.50 per cord, while at most of the mines in N.S. it would probably be worth $2. Mr. Thies unfortunately does not give the cost of labor, so we cannot compare with Nova Scotia, but I have little doubt were it possible it would come out in favor of the latter.

Taking these figures, there is no reason why the cost of chlorinating a ton of concentrates in Nova Scotia should be over $4, and if we take half of the average I obtained from concentrates, I have assayed as a basis, it would leave a net profit of $31.50 on every ton of concentrates treated. If leaching with chlorine water were adopted instead of barrel chlorination the cost of working could I estimate be cut by about 12·5 per cent. The gold in Nova Scotia has a value of between $17 and $20 per ounce, and it is on account of the ores containing such high grade bullion that leaching with chlorine water is able to replace barrel chlorination. One of the main objects of the barrel is the removal by abrasion of silver chloride formed on the particles of gold. Before concluding this paper there is one point more I want to touch upon, it has only recently occupied my attention, so I can say very little about it. While recently at a mine in Eastern Nova Scotia I brought away two samples of slate from the dump. These samples were not average samples, but were selected because they were particularly heavily mineralized. At the same time there were several tons of similar pieces on the dump and a much larger quantity stowed away on the scaffolds under ground.

The following were the results of the assays: (1) Assay value, 11 dwt. 2 grains, yielded 12·5 per cent. of concentrates, having an assay value of 4 oz. 2 dwt. 3 grains. (2) Assay value 17 dwt. 2 grains, yielded 15·6 per cent. of concentrates, having an assay value of 5 oz. 6 dwt. 12 grains. Considering that this mine was running on less than 5 dwt. ore at the time these pieces of slate were dumped, the subject is certainly worthy of further consideration.

Mines and Management.

By ROBERT ARCHIBALD, M.E., Joggins, N.S.

I wish to say that I have with your kind permission, and which I have taken the liberty of assuming granted, preferred to confine the following few remarks to mine management, embracing amongst its various details, management of men, a subject I am afraid which is not too seriously taken into consideration by mining men and others directly and indirectly connected with mines.

Mine management has advanced by leaps and bounds during the past few years, and has now attained such a state of perfection as to be included, or classed, amongst the sciences.

It is well known that a mine manager of the present day to be successful has to have an almost perfect knowledge of several scientific subjects; in fact, to put the whole matter in a nutshell, he is expected to know everything and anything, so much so, that he not only ought to be classed as a scientist, but a multi-scientist, if I might be permitted to use the expression.

The future success of a manager depends largely on his early training, and I cannot lay too much stress on the importance of having good mining schools, which unfortunately are only too limited in Canada. In Great Britain, where the new schools of mine managers are fairly well established, due to a large percentage of them being trained mining engineers and graduates from the various scientific colleges, of which she has an ample and excellent supply all under the direct patronage and support more or less of the government. Most young men on making up their minds to adopt the profession of mining, enter a mining engineer's, or better still, a civil and mining engineer's office, where they serve as a pupil from one to five years' duration, getting no remuneration, and in a great many cases large premiums have to be paid for the privilege of gaining this training. During this probationery period they can attend college either during the day or at night, according to their means or taste, and when this period is completed a situation is generally found for the student at one of the large collieries as assistant manager or surveyor, where he can get the usual practical experience to enable him, if he wishes to become a permanent member of this profession, to go forward as a candidate for the necessary mine manager's certificate. It generally takes, from the time of entering the mining engineer's office until this goal is gained, a period of about seven years, but this is varied by many circumstances which it is unnecessary to mention here. I wish to say that mine managers are not all composed of men of this class, as there are a great many young picksmen endowed with ambition to rise in the world, and who take full advantage of the very cheap and efficient night schools provided in every village, and generally end the race in a neck and neck encounter with their more fortunate—from a worldly point of view—brethren. I have known men to work hard for years in the mines to enable them to save sufficient money to keep them whilst serving as a pupil with a mining engineer's firm. One man in particular with whom I was acquainted was upwards of thirty years of age before he was in a position to undergo this training. He served for four years with a large firm of civil and mining engineers in one of the largest cities in Great Britain, and during that time he enrolled in one of the mining science classes in the university of that city, and at nights attended one of the science and art colleges. He is now a successful mine manager in Scotland. I could quote innumerable cases of a like nature, but it is hardly necessary, as the one will suffice to show that the battle is not always to the man endowed with this world's gear. In the world's fight for position most men, not being born with the proverbial spoon, have to depend on themselves, and this decidedly applies to mining men.

I care not what collieries or mines you visit, you are certain to meet with a more than ordinary intelligent class of workmen, as a miner in nine cases out of ten is a thoughtful man. A thoughtful man as a rule is an intelligent man; and what is more brimful of thought than mining? And when I state that the officials are the very pick of the men, I am not far wrong when I say that mine officials are as a rule more intelligent men than officials of a similar degree in other trades and occupations. To govern and guide these men, a manager or head is essential, and as will be readily acknowledged such a man must be of ready resource, gifted with keen foresight, have a thorough knowledge of his profession, and be able and willing to display energy and tact (a very essential trait of character) at all times.

To the casual observer, perhaps, he might say that little or no thought is required in the initial stages of working a mining property, but I have to say that a good deal more thought is required to this particular case than in many of the most intricate problems of the day, and that the slightest mistake made during this stage of development might result in the ultimate loss of thousands of dollars, if not tens of thousands. When you take into consideration the fact in the case of a slope or shaft having to be sunk for a considerable distance to a seam, say of coal, that such considerations as nature of strata, likely quantity of water to be met with, best position for the shaft, connections with railway or water, transportation and efficient working of the seam; houses and water on surface, faults in strata, and the thousand and one possible drawbacks or otherwise, that have got to be taken into very serious consideration, you will at once admit that a great deal of thought must be brought into action. I know of one instance, where two shafts 350 yards each deep were sunk. The seam dipped in a northerly direction at an angle of 15° towards a river, the boundary of the property, and the main line of railway ran close to this river and parallel to it. The shaft was sunk about a mile from the railway, and on the face of a hill, and which, mark you, dipped in the same direction as the seam, and at the same angle for half the distance, between the pits and the railway. It was a well-known fact that large faults lay to the south and close to the pits, and that it would be an utter impossibility to proceed further in that direction after striking them, although an unsuccessful effort was made. What was the consequence? In a very short time the entire seam to the rise of the pits was worked out, and nothing was left but to work the seam to the dip, involving a large expenditure of money in providing additional pumping and hauling plant for this purpose, whereas had the shaft been sunk about half a mile further to the north they would have had all this extra to work to the rise with the same depth of shaft and same expenditure of money. Of course the portion to the dip would require to have been worked sooner or later, but I say the company would have been more able to bear the increased expenditure under the latter conditions, and with a much less area to the dip to work, instead of being plunged into it almost at the very outset. By sinking at this particular spot the colliery branch line would have been at least half the distance it was, and in itself a very serious item in a country where no government subsidies are given to private enterprise. I know of another case where a shaft was attempted to be sunk in a patch of running sand; very large expense was incurred in endeavoring to get through this, but ultimately it had to be abandoned, and another one sunk about one hundred yards to westward, where no running sand was encountered. In the first of these two instances, the dip of the strata was well known by boring, consequently there was no excuse for the manager sinking his shaft where he did, and in the second the seam they were going to had been worked, and was being worked in the surrounding properties, consequently the manager did not consider it necessary to prove the property by boring, with the above result; but what I would like to point out is that on reaching the sand it would have been as well to have suspended operations and put down a few surface bores, as it is well known that running sand does not extend over a great area, and a few hundred yards either one way or the other would have been immaterial, so far as the economical working of the seam was concerned, and thus saved a great deal of money. The above are, I am pleased to say, isolated cases borne out by my experience in the mining centres of both Scotland, England and Wales.

In preparing to develop a seam of coal, we will assume that period of deep thoughtfulness has been got over and the site of the shaft determined on. The shape and size are according to the ideas of the manager and proposed quantity of output. I prefer a rectangular shaft, as every square inch can be utilized, whereas with circular or elliptical a great amount of space is lost—the shaft to be sunk as far to the dip as possible consistent with shipping communications and

and other essential matters. It is customary in sinking through the surface to do so by means of a windlass worked by hand, and when the shaft becomes too deep for this method of hoisting, generally a small second-hand engine is got to hoist for the remainder of the distance, and as the sinking nears completion the permanent hoisting engines are put in position to be ready to hoist when the pillars supporting the shaft at the bottom are being formed and other development work carried out. It is a matter for reflection whether it would not be advisable to have the permanent hoisting engine in position and ready to hoist almost immediately after sinking operations have been started. As a matter of fact, I believe the work could be done much more expeditiously and safely by this means than any other, as pumping gear could be handled easier, the loads raised could be heavier and more quickly drawn to the surface. Exceeding care has to be exercised in keeping the shaft perfectly plumb, and strongly timbered where soft strata is met with. The timber should be of good, fresh, lasting wood, and the surface and soft measures below it bricked, although this portion of the shaft is often timbered, and in many instances I have seen the shaft timbered from top to bottom. It is customary for the sinkers to carry a midwall or partition dividing the shaft into two for ventilation purposes, the current being carried by either steam jet or water, but as the water has to be pumped up again the steam jet arrangement is the much better of the two. This is done by leading a small steam pipe down into one of the divisions and allowing a jet of steam to escape from it. I need not say very much about the pumping operations, although care must be taken in putting in this plant to make it large enough to cope with any amount of water got—an approximate estimate of which can be easily obtained from the bore hole, if any, and neighboring works and other indications. When the shaft is wet the permanent line of pipes are generally put in by the sinkers as the work progresses, and lodgments for draining and storing the water made at suitable distance apart and according to depth of shaft and length of pumping lifts. Bucket pumps are very often used, but the plunger or force pumps are to be preferred, as they give much less trouble and are more easily repaired in a shaft. Good hydraulic pumps are very efficient, but require close attention.

The shaft having now been sunk we will say, and the task is before the manager of forming the supporting pillars for the shaft. The size of these pillars is determined by the superincumbent strata, and as it is best to be on the safe side, if he is a wise man he will leave them a little larger than he actually requires. I have known where all the coal was taken out at the pit bottom and wooden pillars substituted, but as this operation requires the utmost nicety and precision in performance, I would not recommend it particularly in deep shafts. After the pillars have been formed it now remains to develop the workings, and this can only be determined by the nature of roof and pavement, nature and thickness of coal, and surface structures and natural features. There are two distinct methods of working, viz., longwall and pillar and bord. There are several modifications in the latter system under different names. With the longwall system, when adopted, a much larger percentage of round coal is got than in pillar and bord, the amount of slack made is much less, and altogether, when the seam will admit of it, it is a long way the better mode of working of the two. For the uninitiated I may say that with the longwall system all the coal is removed at first working. The roadways are formed and kept up by wooden pillars, and material got from the roof or pavement. This material is built behind the miner, and parallel to the working face from either side of the roadway. The timber by this method costs more as a rule, as a large quantity is used, but the coal is mined so much cheaper that the extra cost of timber is a long way more than counterbalanced by the cheaply got coal. The main thing, and which must be done in order to make this system a success, is to keep the building close up to the face, and thereby throw the weight of the strata on to the face, making it much easier, and consequently cheaper to mine.

With the pillar and bord system, pillars are formed and sized according to depth from surface, angle of seam, etc., and called the first workings, and when the boundary is reached these pillars are extracted, and the men gradually work their way back to the pit bottom. This is called the second working. The bords are the galleries, driven in, forming the pillars. This system has to be adopted largely, but the percentage of slack got is very large, especially when removing the pillars. In forming the pillars care must be taken to make them large enough. By doing so the quantity of slack coal got is reduced considerably, and any danger from crush averted. I cannot understand it, but it is the case, that a great many managers will make the pillars too small. Although probably this is not done to the same extent as it used to be, and the consequence is that when they come to take them out, if they have not lost them by their imprudence, the quantity of round coal is almost *nil.* Large sections of workings have been entirely lost in this manner, and I know of one colliery where several acres of magnificent splint coal were lost, and so rapidly did the creep or crush come on that the miners in their flight from the working face had to leave all their tools behind them—a rather serious loss to the men, as they were their own property. It does not matter what system of working has been adopted, the development process is much the same. Levels are generally driven at right angles to the rise of the seam, into which all the coal got from the mine gravitates. Other main roads are formed, but the levels are the principal roads from where the coal is hauled to the pit bottom, either by horse, steam haulage, or any other system adapted to the workings.

The foregoing description lightly touched upon of the development of a coal area is merely set down as a basis from which I intend to demonstrate the requirements of the mine manager. At the outset the area has been proved by boring, and from this and other sources of information a plan is made showing a cross section or sections in which the faults got in the strata are marked, and it is from this plan that the position of the shafts are mainly determined on. As already stated, the position of the shafts should be as near railway communication as possible, and in such a position that they will drain nearly, if not all, the water got in working the area. The water got in mining is a serious drawback to cheap working, and it is of supreme importance that the method adopted in getting rid of this water should be such as to reduce this item of expenditure to as low a figure as possible, and it is only by considering the matter well at the start that the mine manager can at all hope to do it at anything like a reasonable cost.

I of course refer not only to coal mines, but to all branches of mining, as the system of water drainage adopted is pretty much alike. When the manager has a good pumping outfit in his mine the worst and initial difficulty to cheap mining has been overcome.

The class of machinery and boilers have also to be carefully considered, and for good effective work a pair of coupled horizontal engines from 24 in. to 26 in. cylinder should be fit to cope with any output. The boilers should be Lancashire, as they are the best boiler extant for mining purposes, and it is always as well to have at least one more boiler than is actually required. This, combined with a good smoke stack, should make a very good outfit. For pumping, when an engine is used, the condensing engine will be found to be a very good one for the purpose. When slopes are used as an outlet for the coal, I have found in a great many instances that the steam is conducted to pumps situated in the workings. I do not approve much of this system of pumping, as I would not, if it can at all be avoided, take steam into the workings. It causes serious deterioration to the section of the workings the pipe may be placed in, and is always a source of danger, and I question very much if the effective power got when the slope has been sunk long distances is very much better than that given by compressed air. In defence of this system it is said that the assistance given to the ventilation more than compensates for its drawbacks; but what is the necessity for this if a good ventilating fan is in operation at the colliery? The steam pipe can be covered certainly, but even with this considerable loss occurs by condensation. Hydraulic pumps are much better suited for this class of work, and although a good pump would cost largely at first, still it would amply repay itself in the long run. Before going further, or rather deeper, we will complete the work on the bank. It is a very necessary matter to have a good steam winch when large pumping plant is in operation, the rope used being round galvanized iron. The pithead frame can be either wood or iron. I prefer iron as being less liable to destruction by fire. I have seen a very serviceable frame made from old railway rails bolted together. When haulage is employed below ground the engine should be situated on the bank, and the ropes taken down the shafts in shones to protect them from the action of the water.

The hoisting ropes, when a heavy load has to be lifted, should be of the very best plough steel, and when only a medium lift is required crucible steel would do. The hoisting drum on engine or pulley on pithead frame should be of large diameter and same size, and the rope should not be at a greater angle than 30° to 35° coming from the drum to the pulley. The machinery and boilers should be built on a strong, solid foundation, and as it is best to err on the right side, the whole of the plant or bankhead structure should be a shade stronger or larger than demanded by the theoretical rules usually employed in this kind of work. Workshops, engine-house, storehouse, powder magazine, etc., have to be erected, but as they are mere matters of detail they need not be gone into here.

The ventilating fan has now to be chosen. Formerly mines had to depend greatly for their ventilating current on the state of the atmosphere or natural ventilation, but this at the best was rather an uncertain state of affairs. Furnace ventilation was adopted, but the system only gives good result when a long motive column can be got as in deep shafts, but owing to the danger from fire accompanying it, it is not to be recommended. Fan ventilation is by far the best and safest method, and although a little costly at first, the accruing results more than compensate the manager for his outlay. There are various kinds of fans in operation, and I do not mean to occupy your time in detailing them, but as they can be inspected at the various collieries and their respective merits inquired into, it only remains for the manager to choose the one that is going to suit him best, but I would say let it be of such dimensions as to add to his ventilating current by at least twenty-five per cent. at any time if required. As to exhaust and blow down fan I prefer the exhaust. On erecting the fan it ought to be placed well back from the upcast shaft, as in the event of an explosion it would run less risk of damage.

In driving the main roads below ground care should be taken to drive them perfectly straight for haulage purposes. When the coal has only to be hauled a short distance, horse traction is the cheapest method of hauling, but when long distances have to be overcome rope haulage is a much cheaper method.

There are two distinct systems of rope haulage in use, the endless rope and the tail rope, and both, where the seam is adapted to them, work equally well. The endless rope does very well in a flat seam, and the tail rope in an undulating seam, and where the roof is frail and narrow roads can only be driven. I have had experience with both, and have a decided preference for the tail rope, as it can be taken anywhere. The endless chain is occasionally used, but its weight is against it. It can, however, be used effectively when the distance to be travelled is not too long.

This latter system would give, I am certain, satisfaction on a long slope instead of the usual method of hoisting now employed.

The tubs used in hoisting the coal should be made from hard, tough wood, built to carry about one ton. I have had experience with steel tubs, but when they begin to wear out they become rather costly to keep in repairs, whereas the wooden tub is much more easily and cheaply repaired.

I knew of a very costly plant of this description having been taken out of a mine, and wooden tubs substituted on this account. The great drawback to large tubs is the difficulty experienced in handling them when they leave the track, but there is no reason why the track should not be maintained in good order, and this difficulty reduced to a minimum.

So far the colliery is now in condition for putting out a large output, and to do this, and to do it at the least possible cost, a competent staff of officials is required. The selection of these men lies with the manager, and if he is looking to his own interests he will choose none but good, steady, efficient workmen. It is of paramount importance to have a thoroughly good underground manager, as the carrying out of the day's work devolves on his shoulders. He it is who sees that the working places are kept in good condition. He can tell at a glance when a prop is awanting, or if a bord is not driven level or straight. He overlooks personally the haulage, and sees that no unnecessary delay occurs, and that the track is kept in good repair. A good man of this stamp is invaluable, particularly if he has good tact in handling the men.

The manager should not be long in discovering the good qualities of his subordinates, and if he has any tact at all he will be able to get more work out of the men by a little judicious kindness than by all the oaths and driving known to the slave driver. This system applies to pickmen as well as officials, and I must say I never knew it to fail. There are some men on whom kindness and forethought are thrown away, and the sooner these are got rid of the better; but in all my experience I never met above half a dozen of such men. A well known and influential mine owner in Scotland once told me that he would prefer giving the men a few pence on the ton rather than have any discontent, and I need hardly say that trouble with his men was an unknown factor. Certainly it is not every mine proprietor who could afford to give his manager such instructions, but at the same time it shows clearly that even small concessions costing little or nothing are not thrown away. There are many things a manager can do to please his men and not cost his employer one cent, and by strict attention to those little details he can soon command the respect of his men, and once that is gained it is, comparatively speaking, plain sailing for him after that. I would not advise any manager to swear at his men, as let miners swear ever so much themselves they do not like it from anyone placed over them, and in course of time simply detest such a man; you can keep your men at arm's length, and still treat them kindly. Miners soon come to recognize when a manager considers himself superior clay to his fellow beings, and woe betide him then, for he will soon have his hands filled with trouble.

I knew of a case where a mine manager, quite a young man too, got along very well with his men. He took an interest in each individual, organized a reading room for them and an athletic club, and his influence was such that when an agitation sprung up in that district for an advance of wages, he was able to keep his men working steadily, whereas the men belonging to the surrounding works lost at least three weeks during a period of about six weeks' agitation. This man, by his masterful tact, saved more to his employers in those six weeks than several years' salary amounted to. In making a promise to a miner, keep to it, even although you should discover eventually that a mistake has been made.

The official whose word can be depended upon, is, generally speaking, a favorité with the men, let him treat them ever so harshly otherwise. The manager should know every man in his employment, and this can only be done by visiting them in their working places regularly. He can hear complaints, as miners as a rule never care about going to the manager with complaints, and he should see that his instructions to his subordinates are being carried out. The manager who does this will have less trouble with his men than the manager who visits them very seldom ; and above all, the manager whose word can be depended on, and who, when he says no, means it.

A few words about strikes and then I will finish. I say that all strikes and lockouts should be declared illegal by law, and whenever dispute occurs it ought to be referred to a board of arbitration whose finding should be final. Quite recently the steel workers in a large work in Great Britain considered that they were not being paid sufficient wages for the work done. They decided on striking, but somehow or another it was arranged that the matter should be decided by arbitration. This was done, with the result that it was clearly proven the firm was not in a condition to advance the wages, and the men are now working perfectly contented.

Great Britain and the United States of America are about to ratify an arbitration treaty, and in my opinion this is an object lesson not only to the nations of the world, but also to the laboring masses of the world and their employers, and I am certain that it only wants the passing of some such law by the government, and strikes and lockouts would soon become a thing of the past.

Gold Mining in the Yukon District.

By W. M. Ogilvie, McGill University.

In these notes I propose not only to give a detailed description of the different methods of gold mining in the Yukon District, but also to give some information in regard to the various routes by which one may arrive at the gold fields, and also to give some points which may be of special interest to the miner.

The Yukon District, as I will refer to, will be understood to be the country adjacent to the Yukon river, from where the International boundary crosses the river, thence up the river for several hundred miles.

Of the different routes by which one may go into the country, the one which affords the least trouble and hardship is via Seattle or San Francisco to the mouth of the Yukon river by the ocean steamer, there transferring to the river steamer, and thence up the river. This route is not patronized to any great extent by ingoing miners. In the first place they cannot arrive in the mining country until about the first of August, which time is rather late to begin any operations in prospecting. Secondly, it takes about double the time to get in by this route that it does by the others. In the third place, ingoing miners are usually not in such a good financial standing as to pay their way while there is a means of working it.

In regard to the other routes, in general it may be said that they all start from Juneau, cross the mountains in different places, and strike the head waters of tributaries of the Yukon river, thence floating down stream to the mining camp at which the miner may desire to locate.

There are several of these routes, and as they would all answer fairly well to one description, I will only go into detail with the one which is being chiefly used at present.

Starting from Juneau and travelling along the coast in a northerly direction for a distance of about one hundred miles, we arrive at the head of Lynn canal. At the head of this arm of the sea there are a number of rivers flowing in, three of them which lead up to low divides in the mountains, which are at the heads of tributaries of the Yukon.

The first river one would meet when going in is the Chilkatt, which flows into the Lynn canal on the left hand side. The head of this stream is at a low divide in the mountains known as the Chilkatt Pass, while on the other side of this pass a tributary of the Yukon known as the Tahk-henna river takes its rise. The portage from the head of the Chilkatt to the head of the Tahk-henna river, is rather a long one, and consequently this route is not travelled to any great extent.

The next river which enters Lynn canal is known as the Skagway, which flows in on the right hand side. This river takes its origin at a low divine known as White Pass, while directly on the other side of this pass, the tributary of the Yukon known as the Lewes river rises. This route has not been patronized in the past, as difficulty has been experienced in going up the Skagway river, as it possesses a number of bad canons. The White Pass possesses some advantages over the other divides. In the first place it is not so high, being about 2,500 feet above the sea, and secondly firewood may be obtained nearly all along the way, which is a very important feature. This portage is about forty miles long.

The next route, which is the one usually adopted, is by the Taiya river, which flows in at the head of Lynn canal, and the Chilkoot Pass to Lake Lindeman, which is at the head waters of the Lewes river.

This portage is about thirty miles long, and is a somewhat difficult one to travel on. The pass is about 3,500 feet high, and for a distance from six to eight miles, firewood is not to be had, which induces severe hardship at times.

The miners usually start early in the spring, sometimes in March, and haul their outfits over to Lake Lindeman. Here some of them remain until the ice breaks, in the meantime building their boats and making preparations for their down stream journey. The miners who have not remained usually continue their journey on the ice until it becomes dangerous, when they stop and build their boats, starting off as soon as the water is clear of ice.

A few remarks as to the methods of boat-building may not be uninteresting :

A suitable site being selected, where the largest trees are the most convenient, a frame-work of four vertical posts, which are in the form of a rectangle, the length of this rectangle depending on the length of the boards which are required for building the boat. The two posts at one end are somewhat shorter than those at the other end, and on top of these posts at both ends are placed cross pieces, on which rest the logs which are to be sawn into lumber. After the trees have been cut down and trimmed, they are cut up into the necessary lengths, and placed on top of this frame-work, where they are marked with a chalk line and slabbed with a whip saw, the process of whip sawing being as follows :—One man stands on top of the log to be sawn, which is placed on top of the frame work which has been constructed, and another man stands underneath, alternately pulling a saw up and down, at the same time both men guiding the saw so as to follow the mark which has been made by the chalk line. Continuing in this manner the necessary lumber is obtained, and the building of the boat is started.

The first step is to make a frame for the boat; this is usually made of 2 inch by 2 inch, or 3 inch by 3 inch scantling, except the keel, which is made heavier, depending on the size of the boat. Sometimes a keel is not used, the boat being in the form of a rectangular box, the bottom having a slight batter towards the ends.

When a keel is used the boat has the form of a V in section, and tapers in towards the ends. This latter form is the better one, as it is much easier to control, and may be used in going up stream.

After the frame has been fastened together the next step is to sheet it on the outside with boards; much care is needed in this part of the work, as the boards must fit together tightly. The edges of the boards are usually planed, thus giving them a much smoother surface. When the sheeting is finished all the joints and cracks are well caulked with oakum and then well coated with pitch. This pitch is a mixture of spruce gum and grease; it being thoroughly mixed and melted, is put on the boat when in a fluid condition, and allowed to cool. The grease tends to make the gum tough and not so apt to crack. After the boat has been well pitched it is then launched and ready for use. They are usually fitted up with masts and sails, which are of great assistance at times on the lakes.

Continuing our journey from the head of Lake Lindeman; the first seventy-five miles of which consists of a chain of lakes connected by small streams.

Lake Lindeman is about five miles long, and is connected to next lake, namely, Lake Bennet, by a short swift stream about three-fourths of a mile in length. About midway in this stream there is a sharp bend, and at the foot of this bend a large rock projects out, which makes it very dangerous for going through in a boat. This is always portaged, the portage being an easy one, being a low sandy flat.

Lake Bennet is twenty-six miles long, and averaging about two miles in width. At the foot of this lake a small stream flows out to the right, into Lake Noses, which is an arm of Tagish Lake. Tagish Lake is about thirty miles long, and is connected to the next lake, namely, Lake Marsh, by a small stream about six miles long, known as Tagish River. Near the foot of this stream on the right hand side are situated a number of frame houses, which belong to the Tagish Indians; this chain of lakes being their hunting and fishing grounds.

Lake Marsh is about twenty miles long, and is drained by the Lewes river proper, flowing out from the left hand corner. Here the river is about two hundred yards wide, and it maintains this width for a distance of about twenty-five miles, where it suddenly narrows up to about thirty yards, and averages this width for five-eights of a mile. This part of the river is known as the Canon, its sides consisting of columns of ballast from eighty to one hundred feet in height. About midway in the Canon there is a circular busin about one hundred and fifty yards in diameter, with steep sloping sides. The total fall in the Canon is about thirty feet, and consequently the water is very swift, and portaging is usually done at this point, there being a good portage road on the right hand side.

Below the Canon there is a stretch of rapids for about a mile, then half a mile of smooth water, following which are the White Horse Rapids, which are about three-eighths of a mile in length.

This rapid is by far the most dangerous one on the river, and is very unsafe for boats, being scarcely ever run through, except by accident. It is confined by low basaltic rocks, which at the foot suddenly close in, and make the channel about thirty yards wide. It is here the danger lies, as there is a sudden drop, and the water rushes through at a tremendous rate.

On the west side a portage road has been constructed, and roll ways have been put down in same places on which to shove boats over.

The distance from these rapids to Lake Labarge is about thirty miles; about half way down the Tahk-heena river joins the Lewes.

Lake Labarge is about thirty miles long, and averages four miles in width. This lake was named after one Mike Labarge who was engaged by the Western Union Telegraph Company, exploring the river and adjacent country, for the purpose of connecting Europe and America by telegraph, through British Columbia, Alaska, and across Behring Straits to Asia, and thence to Europe. This exploration took place in 1867, but the successful laying of the Atlantic Cable, put a stop to this project, and the exploring parties were recalled as soon as possible.

Below Lake Labarge the river is very swift and crooked. About twenty-five miles below the foot of the lake, the Tes-Lin-Too River joins the Lewes. A few miners have prospected parts of this river and report very favourably on it as a gold producing stream, but as it is difficult to procure enough provisions to last any length of time, there has consequently not been much work done in mining.

Below the Tes-Lin-Too, there are a number of rivers which join the Lewes, all of which carry gold to some extent, but on account of the difficulty of obtaining provisions in this part of the country, they never have been worked to any extent.

The next notable part of the river is known as Rink Rapids. Rink rapids are formed by several islands standing in the channel, and backing up the water so much as to raise it about a foot, causing a swell below for a few yards These islands are composed of conglomerate rock, similar to the cliffs on either side of the river.

Six miles below these rapids there is another rapid known as Little Rapid. It is simply a barrier of rocks, which extends from the westerly side of the river half way cross. On the easterly side the water is smooth and deep.

The next remarkable part of the river is at the confluence of the Pelly River, which is about sixty miles below Rink Rapids.

At the mouth of the Pelly there are a great many islands. Below the junction a short distance stands all that remains of the Hudson's Bay Company's trading post. This post was established by Robert Campbell in 1848.

He only remained in the country about four years, as the Indians became hostile and gave him a limited time to get out of the country; after he left they pillaged the place and set fire to it.

Below the mouth of the Pelly, the river widens out to about six hundred yards, and maintains this width for about a hundred miles, when it is joined by White River.

White River is readily distinguished by the amount of sediment it carries, it being impossible to see through more than one-half an inch of the water. It is about one-quarter the size of the Yukon, and its waters discolor the waters of the Yukon completely, and a couple of miles below the junction the whole river appears as muddy as White River.

The reason of White River being so muddy, is because it flows through a bank of white volcanic ashes. This bank is about one hundred feet deep and thirty miles from the mouth of the river.

The distance from the mouth of White River to the boundary is about one hundred and fifty miles. There are a number of important rivers flowing in along this part of the river, which carry gold in large quantities, and are being worked at the present time.

The first one is Stewart River, which enters about ten miles below White River. It is said to be one of the richest rivers in the country;

it has been worked for several years and gave good results, but on the discovery of a new mining camp, was abandoned.

The other streams are Sixty-Mile and Forty-Mile Creeks, on which are situated the great mining camps of the present.

At the mouth of these streams there are trading posts, the largest one being at the mouth of Forty-Mile Creek. These companies supply the miners with their mining equipment and provisions.

After the miner has obtained all that is necessary for a prospecting trip he starts out to select a claim for himself. The method of prospecting is as follows: When a miner discovers a bar he "prospects" it by washing a few panfulls of the sand or gravel of which it is composed in his pan. According to the number of "colors" or specks of gold he can find in his pan, after all the dirt has been washed out, he judges of its richness.

The process of "placer" mining is as follows: After clearing away all the coarse gravel or stone of a patch of ground, the miner lifts a little of the finer sand or gravel in his pan, which is a broad shallow dish, made of sheet iron; he then puts water enough in the pan, and gives it a few rapid whirls and shakes; this tends to bring the gold to the bottom on account of its greater specific gravity. The dish is then shaken and held in such a way, that the gravel and sand are gradually washed out, care being taken as the process nears completion to avoid letting out the finer and heavier parts which have settled at the bottom. Finally all that is left in the pan is whatever gold may have been in the dish, and some black sand, which almost invariably accompanies it. Should the gold thus found be fine, the contents of the pan are thrown into a barrel containing water and a pound or two of mercury. As soon as the gold comes in contact with the mercury it combines with it and forms an amalgam. This process is continued until enough amalgam has been formed to pay for "roasting." It is then squeezed through a buckskin bag, all the mercury that comes through the bag being put back in the barrel to serve again, and what remains in the bag is placed in a retort, if the miner has one; if not, on a shovel, and heated until all the mercury is vaporized. The gold remains in a lump, with some mercury held in combination with it.

This method is called the "pan" or "hand" method, and is never continued for any length of time on account of its slowness, but a rocker or sluice box is used when possible.

A rocker is simply a box about three feet long and two feet wide, made into two parts, the top part being shallow and having a heavy sheet iron bottom, which is punched full of one-quarter inch holes. The lower part of the box is fitted with an incline shelf, about midway in its depth, which is six or eight inches lower at its lower end than at its upper. Over this is placed a heavy woollen blanket. The whole is then mounted on two rockers, and when in use it is placed on two blocks so that it may be readily rocked. After the miner has selected a place for his rocker, which must be near a good supply of water, he clears away the stones and coarse gravel, gathering the finer material in a heap near his rocker. The shallow box on top is then filled with this finer sand and gravel, and with one hand the miner rocks it, while with the other he pours in water. The finer material with the gold falls through the holes on to the blanket, which checks its progress and holds the finer particles of gold, while the sand and other material passes over it into the bottom of the box. Across the bottom of the box are fixed thin slats, behind which some mercury is placed to catch any particles of gold which may escape the blanket. If the gold is nuggety, the large nuggets are found in the upper box, their weight detaining them until all the lighter material has passed through, and the smaller ones are held by a deeper slat at the outward end of the bottom of the box. The piece of blanket is at intervals taken out and rinsed into a barrel. If the gold is fine, mercury is placed in the bottom of the barrel as already stated.

Sluicing is always employed when possible; it requires a good supply of water with sufficient head. The method is as follows:—Planks are obtained, and formed into a box of suitable width and depth, slats are fixed across the bottom of the box at suitable intervals, or shallow holes bored in such order that no particle could run along the bottom in a straight line and escape without running into a hole. Several of these boxes are then set up with considerable slope, and are fitted into one another at the ends like joints of a stove-pipe. A stream of water is now directed into the upper end of the highest box. The gravel having been collected as in the case of the rocker, it is shovelled into the upper box, and is washed downward by the water. The gold is detained by its weight, and is held by the slats or the holes mentioned. If it is fine, mercury is placed behind the slats or in the holes to catch it. In this manner a great amount of dirt can be handled, and consequently a great amount of gold secured in a given time. After the boxes are done with they are burned, and the ashes washed for the gold in the wood.

The miners call Sixty Mile and Forty Mile creeks "bed rock" creeks. They are creeks in which the drift is not very deep, varying from six to thirty feet. In such streams nearly all the the gold is found laying on bed rock. In places where the drift is shallow they usually ground sluice—that is, they drive the top surface off with water.

In places where the pay streak is deep the miners have devised another scheme, namely, that of "burning" or thawing out the ground in the winter time.

As the frost never leaves the ground during the entire year, and the small streams freeze solid in winter, the miners are not troubled with surface water, consequently a great amount of dirt can be taken out during the winter, and be in readiness for the first spring freshet.

The method of working is about as follows:—Early in the winter, as soon as the snow comes, wood is hauled to the mine, where it is chopped into three or four foot lengths, this wood being about one-half green and the other half dry. After enough wood has been procured, a patch of ground is cleared of snow, and a pit three feet wide by seven feet long is started. This is usually picked out until the gravel is reached, then fires are made and the ground thawed out. This is continued until bed rock is reached. As soon as bed rock is reached, drifting is commenced; that is the gravel which lays on the bed rock and contains gold is thawed out and lifted to the top of the ground, where it is dumped in a heap, ready to be shoveled into a sluice box.

Two fires a day are usually made, a fire requiring two armfuls of wood, one green and one dry, the green wood being placed on top of the dry, thus helping to keep the heat in. One of these fires thaws out about twelve bucketfuls of dirt, a bucket being eighteen inches square at the bottom, twenty-two inches square at the top, and nine inches deep. This method enables the miner to handle a large amount of dirt, being able to work all the year round; otherwise he can only work on an average seventy days in the summer season.

When the miner gathers the gold from the sluice boxes it is usually mixed with dirt, and has consequently to be cleaned. The process of cleaning is called "blowing," and is executed as follows:—After the gold has been thoroughly dried, small quantities of it are put in a small shallow pan, which the miner possesses for the purpose. He then tosses the gold in the air continually, and at the same time blowing it, thus separating the light dirt from the heavy gold. This process is continued until the gold is thoroughly cleaned, when it is ready to be used.

Asbestos Mining and Dressing at Thetford.

By H. Nellis Thompson, Quebec.

Canadian asbestos, as is now pretty well known, is not the asbestos proper of the mineralogist, which is a variety of hornblende, but is a fibrous form of serpentine called chrysotile. It is an hydrated silicate of magnesia, and is easily distinguished from the asbestos proper by its yielding water when heated in a closed tube.

It occurs in that part of the great serpentine belt of the Eastern Townships, which extends from the township of Broughton on the north-east, to that of Ham on the south-west, and includes the townships of Thetford, Coleraine, Ireland and Wolfestown.

The asbestos-bearing serpentine is from 10 to 100 feet wide, and contains veins varying from a mere thread up to 4 inches in width, and which intersect the mass of rock in every conceivable direction.

Asbestos mining at Thetford is conducted wholly by quarrying. The quarries are in some cases from 70 to 120 feet deep.

Drilling is carried on by means of compressed air, the form of drill used being Rand's "Little Giant, No. 3," working at a pressure of about 80 lbs. to the square inch. The steel used is 1⅛ inch, and has a X shaped bit. Holes are drilled from 8 to 12 feet in depth, and an average day's work of 10 hours is about 60 feet.

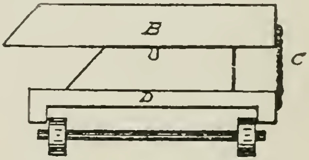
Dualin, which contains 40 per cent. nitroglycerine, is the explosive used for blasting. The holes are about one-third filled with this and then tamped lightly with loose borings, by means of a wooden rod. The firing is done with a 25 hole "Pull Up" battery, several holes being connected in series and thus fired simultaneously. In blockholing, *i. e.*, blasting detached blocks of rock which are too large to be conveniently handled, hand-drilling with ⅝ inch steel is employed, and the holes are fired by fuse.

Pumping is a very small item in the expenses of the mine, as very few springs are met with, and the surface water which falls into the pit is quickly disposed of by steam pumps.

Hoisting from the pit is accomplished by boom-derricks, the boom being usually about 50 feet long. Copeland & Bacon hoists are used to operate the derricks. These are driven by compressed air conveyed from a Rand Duplex compressor by a 4-inch wrought-iron pipe. This method of working the hoists is found to be much more convenient than steam, as work is kept up to some extent most of the winter.

Cable derricks are now being used by the Bell's Asbestos Co. in addition to the ordinary boom-derricks. These consist of a mast with a 2 to 3-inch steel cable stretched from it across the pit. A traveller runs on this cable, and hoisting may take place from any point of the pit directly below the cable. This system, although often slower than the boom-derrick, presents many advantages, as the cable may be stretched a distance of over 400 feet, and its anchorage is easily moved.

The ropes used in hoisting are generally of ¾ inch steel, and last about two years when properly cared for. The cages or baskets are of wood, iron bound and with iron-lined bottom. They measure about 4½ x 6 x 1 feet, and are open at the front. They have a piece of metal rail fastened across the bottom on the outside, which fits into a groove when landed on the cars. A load for one of the baskets is from 1 to 2 tons.



A simple type of side dumping car is used. This consists of a platform car with pieces of wood fastened across the top shaped as shown in Fig. 1. The loaded basket hoisted from the pit is landed on the car. Fig. 1 is an end view of one of the cars with basket in position. B is the basket, which is prevented from tipping over by the chain C. D is the platform car. Each car holds two baskets, which empty on opposite sides. A carload is thus from 2 to 4 tons, as each basket load is from 1 to 2 tons, as previously stated. When the car is to be emptied, the chain C has only to be undone, when the basket B overbalances and its contents are discharged.

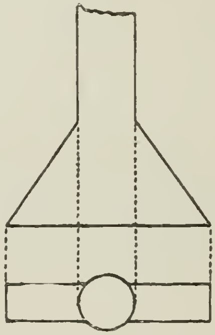
The car being loaded runs down a trestle, built on a grade of about 1 in 16, passes the dressing establishment, or "mill" as it is called, and empties at the dump. The loads containing asbestos veins are discharged upon the trestle in the rear of the mill. This material is then shovelled down a chute into an iron self-dumping skip. This, when loaded, is hoisted up an incline of about 45 degrees to the top story of the mill, by means of a small friction hoist, and dumped in front of the crusher. The empty cars are brought back to the quarry by horse.

At the dump several boys are employed hand-cobbing, as many pieces of the waste rock have asbestos still attached to them in small quantities.

Before describing the "dressing," a few words on grading are necessary. This is done in five qualities: 1. No. I., being the longest fibre, from ¾ inch up, and especially valuable for spinning. 2. No. II., from ½ up to ¾ inch, also used for spinning. 3. No. III., shorter than No. II., and used in the manufacture of millboard, etc. 4. "Waste" (not to be confounded with the term waste rock previously employed), consisting of still shorter pieces of fibre mixed with a large proportion of serpentine sand, and used in manufacture of bricks, cements, etc. 5. Fibre, a very soft variety almost free from rock, and used for purposes such as steam packing. The percentage of rock in the different grades is extremely variable, that in No. 7 sometimes varying as much as from 5 to 40 per cent.

The crude material is first put through a Blake crusher, the jaws of which are set at ¾ inch. From the crusher it goes on to an inclined 1-16 inch mesh preliminary screen. Thence it goes to a travelling picking table, which has a division along its centre. Here boys are busily engaged removing the barren rock to one side, and that containing asbestos to the other. At the end of the table the former drops into a chute, while the latter falls on to a carrier and is conveyed to the rolls. These are of the geared Cornish type. Their springs are adjusted so as not to exert too great a pressure between the faces of the rolls, as this would cause the rock passing through to cut the fibres. From the rolls the stuff passes over inclined screens shaken by an eccentric, this being arranged in the following order, viz: 1 16, ½ and ¾ inch. From the preceding remarks on grading, the object of this arrangement becomes apparent: the waste dropping through the 1-16 inch mesh, No. 3 through the ½ inch, No. 2 through the ¾, and No. 1 over the end. The waste from the 1-16 inch mesh screen is conveyed by a chain elevator to the waste box. No. 2 to ensure a more uniform product is screened a second time on a ¼ inch mesh screen, and the screenings from this, consisting of pieces of serpentine with asbestos attached, are put through the process for obtaining the fibre.

The plant for this consists of a Cyclone mill opening on to a screen. This screen has 11 meshes to the inch, is covered for about two-thirds of its length, and is suspended from the ceiling of an air-tight room by four hickory rods. Over the lower end of it hangs a funnel, shaped as in Fig. 2, and connected by pipe with a circular blowing machine on the next floor. From the blower a pipe runs to a small room above, the window of which is covered by a fine screen.



The material being shovelled into the Cyclone, which is run at the high speed of 2,300 revolutions per minute, is caught by two whirlwinds revolving in opposite directions, and the pieces of material thus become pulverized by attrition. The lumps of serpentine being broken up by this means, the fibre is freed and both pass together to the screen, where most of the pulverized rock is shaken out. The rest passes over the end of the screen, while the fibre is sucked up through the funnel by the blower, which makes 2,700 revolutions per minute, and is blown into the room above, the screen on window preventing it from being blown outside. About 35 per cent. of the material put through this process is obtained as fibre.

The different grades are put up in bags of 100 or 200 lbs. and shipped by the Q. C. R.

In closing, a few words on the manufacture and uses of asbestos may prove interesting.

The material from the dressing establishment is put through a machine for the purpose of separating the fibres from one another, and from the non-fibrous material, a quantity of which is still present.

One form of this machine consists of two rollers covered with teeth, revolving usually at equal peripheral speeds, and at the same time having a sideways motion in relation to one another. By the pressure the fibres are loosened, and being loosened are combed apart by the reciprocating motion. After this operation there is nothing special, the long fibre being spun and woven as any other textile, and the short fibre being treated like paper pulp.

All asbestos goods may thus be classed, as regards the process of manufacture, as paper or yarn.

In addition to the uses already stated in connection with grading, the following may be mentioned: Fire-proof paints, roofing felt, covering for pipes and boilers, fire-proof clothing, rope and cord.

This paper has been written with the intention of giving a general idea of the method of mining and dressing asbestos at King Bros.' mines, Thetford.

The methods employed by the other companies working there, are very similar on the whole, differing, however, in such matters as the use of different makes of drills, steam instead of compressed air for drilling, and hoisting cars of a different pattern, etc.

Notes on the Western Ontario Gold Fields.

Dr. Coleman.—Mr. Chairman, I see that both Mr. Hille and myself are down for this subject, and if Mr. Hille is ready I will be very glad to allow him to read his paper, because I have been so crowded with work that I have nothing but rough notes put together.

The President.—Mr. Hille is not present.

Dr. Coleman.—Then, if you will allow me, I propose simply to talk for a time on the subject. If you will allow me, I shall call attention to these maps that I have here. I have not taken the excellent maps belonging to the Geological Survey for the reason that they are on a smaller scale. These I have here are on the scale of two miles to the inch. The maps of the Geological Survey of the Rainy Lake and other districts, while more accurate and better colored, are, however, on too small a scale.

In was intended in this paper to take up the geology of the Western Ontario Gold Mining region. The geology of this region is very interesting in itself, and we have to credit one of the members of the Geological Survey, Dr. Andrew C. Lawson, now of California University, for the first really careful description of that region that I am going to speak of—that is of the Rainy River and Lake of the Woods District. He must be accepted as laying the foundation of our knowledge of these districts. He found that we have there Laurentian and Huronian rocks in very peculiar relationship. The Laurentian rocks are in rounded areas, half a mile or a number of miles in width enclosed by Huronian rocks in a wide set of meshes. The Laurentian rocks in this region consist chiefly of granite, granite gneiss and syenite gneiss, while the Huronian rocks are chiefly volcanic, eruptive flows and metomorphic volcanic ashes, but sometimes water-worn conglomerates. Now Lawson's idea was that these granitoid rocks pushed up as eruptive masses through the schists nipping in the latter as synclinal folds with bedding having a steep dip away from the Laurentian. This theory is one that does not correspond with the usual idea of the

Laurentian as being formed in a great many cases of modified sedimentary rocks laid down in greatly disturbed territory. However, we have evidence that the Laurentian rocks in very many cases, if not all, are of an eruptive character, so that the term Laurentian is used in a petrographical, not an historical sense, from the geological standpoint. Lawson was not quite sure about the Huronian age, and therefore he called these rocks, Keewatin. An area of more or less modified sedimentary rocks, consisting of sandstones, mica schists and gneisses, Lawson names Couchiching and places beneath the Huronian; but as they are seldom or never gold-bearing they require no further mention here.

I now propose to take up the different types of gold-bearing deposits, and give you a few of the most prominent examples that illustrate them. The first and most important of these types is that of the true fissure veins of which we find a large number of cases. In this region they are confined chiefly to eruptive rocks especially granites and less frequently occur in schistose rocks. In the Shoal Lakes hundreds of fissures have been formed in the granite, and these fissures have been filled with quartz containing a certain amount of gold. There was a time when it was supposed that these veins were not likely to go very deep; in fact, some supposed that they would soon run out. That is not true; they have been traced along the surface in many cases thousands of feet, and they may just as well go down thousands of feet. The deepest shaft is now down to a depth of about 200 feet, and the vein is as wide there as at the surface, in some cases wider. The Foley, the Ferguson, the Lucky Coon and other mines are now being developed on deposits of this kinds. Two or three of these are well established mines, and it is probable that a large quantity of gold-bearing quartz will be obtained. Fissure veins sufficiently rich to be of importance have been found nearly always associated with eruptive granites. On Sawbill Lake however, there occurs a deposit which is not in granite but in a gneissoid rock, but the veins are of the same character, true fissure quite rich in gold. One of the shafts in the Sawbill mine has been sunk to a depth of 160 feet. We have examples of the same sort in the Harold Lake mine.

True fissure veins may also occur in Huronian rocks. The best example I know of at present is in the Manitou region, on the Crawford property, H.P. 301, north of Lake Manitou, where a well defined true fissure vein three or four feet wide may be traced for a quarter of a mile or more, across the strike of the schistose country rock; and a somewhat narrower one for a still greater distance.

The next type of ore deposit that is valuable in this region is what may be called the bedded or segregated, or lenticular vein. Bedded veins are interpolated between the schists and run parallel with their strike. They are generally lenticular in shape, and when a lens runs out another often replaces it a little to one side. Frequently several layers of schists are more or less parted, bands of quarz of varying thickness billing the space between, where the ore body may have ill-defined limits; but in many cases the lenses have tolerable definite walls, though seldom so distinct as in the case of true fissure veins. There may be a single lens or there may be a series of them in the Huronian rocks. There are cases of lenticular deposits, however, that occur in what has been called, Laurentian. The best example that we have of this sort is the Sultana mine, where at least two large lenses have been found; one of a considerable width has been traced along the shore for 1,800 feet, the country rock being a grey schist, probably formed by the heaving of a mass of porphyritic gneiss as it pushed up through the Huronian rocks, the latter now largely removed. When the upper lens was about worked out, Mr. Caldwell was so fortunate as to strike another very much larger body of quartz, hundreds of feet long, and at some points 40 feet wide with a little schist included. While the most important instance that we have of lenticular ore deposits occurs in what is generally looked upon as Laurentian rock, a great many examples of bedded deposits occur in the Huronian, where there are sometimes whole series of quartz stringers in the schistose rock uniting at some points perhaps to larger quartz masses. An example of this kind is to be seen in the Little America mine on a small island just south of the border in Minnesota. In other cases there are bedded veins that do not differ much from fissure veins. Probably one of the most prominent examples of this kind is at the Empress mine, near Jackfish Bay, at a point not shown on this map. There bedded veins have been traced for miles, and the majority of the locations that have been taken up by the gold miners of that region are to be looked upon as of this character. Next contact deposits may be referred to, where one great mass of rock comes in contact with another. The Mikado mine on Shoal Lake has been said to be of this character, but in reality cannot properly be so classed, since the vein does not lie to any appreciable extent between Granite and Huronian rocks, but cuts across the contact, being enclosed at one end in granite and at the other in diabase in both a more or less regular fissure vein. Again the Regina mine has been spoken of in the same way. Here also a true fissure begins in the granite and passes into the schistose rock afterwards. I do not know in fact of a single typical instance of a contact deposit, except one, and I am not aware that it has been proved especially rich in gold.

Besides these varieties of gold-bearing deposits there are two or three that may be of value, but have not so far proved to be of great importance. Among these are Fahlbands, bands of schistose rock, impregnated with sulphides. They may carry a little quartz, and in that case they will form transitions to the lenticular variety of ore deposits. The best known of these fahlbands is one near Rossland, north of the Canadian Pacific at Rat Portage. This runs north-east and south-west including the Scramble, Benson, and other locations, is 25 or 30 feet wide in places, and it is stated, has been traced for several miles. The gold carried is very fine, but is easily shown by panning. These locations were taken up in a very singular way. A prospector of Scandinavian origin had a friend in the Old Country who owned a divining rod of great power. He sent for it and located with the divining rod several of these claims. There are examples of similar fahlbands in the Manitou and Little Turtle regions, though not quite so extensive as near Rat Portage. Some of these deposits will be important if they carry even three or four dollars a ton of free milling gold, because they are unlimited in extent. Up to the present they can scarcely be called mines, but rather prospects. Another variety of deposit occurs in dykes of porphyry or felsite, which are found wherever granite or gneiss comes in contact with Huronian rocks. These dykes are usually found spreading for instance from the Laurentian into the Huronian. Quartz has been deposited in fissures that were formed from the shrinkage of the dyke rock while cooling, or the dyke may have formed a line of weakness along which later fissures were made. The quartz thus associated with felsite or porphyry often carries gold. Whether the dyke as a whole will be workable is a question, since the gold ore of these dykes has never been mined as yet to any important extent. As in the case of Fahlbands the question as to their value has not yet been settled. Whole bosses or masses of eruptive rock are said to be in some cases gold bearing, as for instance the whole mass of granite at the Treadmill mine in Alaska. The only instance of the kind in Ontario that I know of is on Round Lake not far from the Huronian mine. Here a considerably altered quartz porphyry contains iron and copper, pyrites, fluor spar and other minerals, and I can testify that there is gold in it, but the assays so far made do not seem to show that there is enough to pay. However, if you have a square mile of material there need not be a great deal of gold to make it pay.

Now I have taken up the main types of ore deposits in Ontario. You will find that there is a considerable variety, but I am not aware that there is a single example of a mine that is more than a mile or two from the contact of the Huronian rock with the Laurentian rocks or granite, and several of the best are just at the contact. Wherever you find this contact there may be gold deposits; that at least is the present experience. They may occur either in Laurentian granite or Huronian schists or in bosses of eruptive granite.

Since I had this subject in my mind I have been informed that a quite similar contact zone near Lake Winnipeg has proved to have gold-bearing deposits and there does not seem any limit to the possible discoveries of gold where Laurentian meets Huronian in our northern territories.

Some Boiler Tests at Drummond Colliery.

By CHAS. FERGIE, Westville, N.S.

In bringing before the notice of this Society some recent boiler tests made at the Drummond Colliery with water tube boilers of different design, it is not with a view of criticising one or other boiler, but simply to show what is actually being accomplished in every day practice, and to promote discussion thereon; also with a hope that other members may be induced to take up so important a matter, and that by giving their practical experiences with the different boilers at their works, some useful information and comparisons may be elicited which will be of value to mine managers, whether of a coal or gold mine.

The boilers tested were two Stirlings and one Heine. The Stirling boilers have been in use some three years, the Heine boiler five years. Both Stirling and Heine boilers give entire satisfaction, and no trouble has been experienced with either since their erection. They are both quick steamers, will burn almost any class of fuel and supply dry steam. There has been no renewal of tubes in either make of boilers, and there have been no leaky tubes. Repairs to both the Stirling and Heine boilers have been very slight, the Heine having the advantage in that it has no fire box arch to contend with.

The actual cost of erection of the boilers was as below:—

ITEMS OF COST.	Stirling Boiler, 300 H.P.		Heine Boiler, 200 H.P.	
Makers' Invoice	$3450.00		$2600.00	
Smoke stack and breeching	554.00		212.18	
Duty on boiler	1035.00			
Freight on boiler	238.66			
Exchange	4.40			
		$5282.06		$2812.18
Labor erecting	925.05		275.20	
Stores erecting	1196.02		340.62	
		$2121.07		$615 82
Total cost		$7403.13		$3428.00

When comparing the rating of the two different makes of boilers it must be remembered that with the Stirling Co. one H.P. equals 30 lbs. of water evaporated per hour from 100 deg. F., at 70 lbs. pressure. The Heine Co. calculate one H.P. equals 30 lbs. of water evaporated per hour from 212 deg. F., at 70 lbs. pressure.

For comparisons of the cost per H.P. of the two boilers we will assume the Stirling system of rating, and it is seen that the Stirling comes out $20.70 per H.P. developed as against $14.85 per H.P. developed by the Heine.

As it is the writer's intention to make further tests he will for the present make no further comments, but will supplement this paper at an early date.

TEST OF STIRLING BOILER AT DRUMMOND COLLIERY, WESTVILLE, N.S.

DATE OF TRIAL, MAY 10TH, 1897.		
Duration of trial	Hours	8
Flat grate furnace		
Total grate surface	Sq. ft.	78
Total heating surface	Sq. ft.	3,300
Number of boilers in use		2
AVERAGE PRESSURES.		
Steam pressure in boiler by gauge per square inch	Lbs	110
Force of draught	In.	0.5
AVERAGE TEMPERATURES.		
Of external air	Deg.	47
Of fire room	Deg.	71
Of feed water before entering boiler	Deg.	151
FUEL.		
Class of coal—Bituminous, Round, Main Seam.		
Moist coal consumed	Lbs	11,913
Moisture in coal	Per cent.	1.27
Dry coal consumed	Lbs	11,761
Total dry refuse	Lbs	1,434
Total dry refuse	Per cent.	12.19
Total combustible	Lbs	10,327
Dry coal consumed per hour	Lbs	1,470
Combustible consumed per hour	Lbs	1,290.87

BRITISH THERMAL UNITS.		
Number of heat units in a pound of dry coal by analysis	B. T. U.	13,402
Total heat units absorbed by boiler	B. T. U.	95,263,190
Heat units imparted to boiler per pound of dry coal	B. T. U.	8,099
Heat units imparted to boiler per pound of combustible	B. T. U.	9,224
Factor of evaporation for boiler		1.106
EFFICIENCIES.		
Efficiency of boiler based upon dry coal	Per cent.	60.4
Efficiency of boiler based upon combustible	Per cent.	68.82
WATER.—Water actually evaporated	Lbs.	89,232
EVAPORATIVE PERFORMANCE.		
Water actually evaporated per pound dry coal	Lbs.	7.58
Equivalent per pound of dry coal from and at 212 deg. F.	Lbs.	8.38
Water actually evaporated per pound of combustible	Lbs.	8.64
Equivalent per pound of combustible from and at 212 deg. F.	Lbs.	9.55
COMMERCIAL HORSE POWER.		
On basis of 34½ lb. of water from and at 212 deg. F., to steam of 70 lbs. gauge pressure, per hour by boiler	H. P.	357.61
Horse power, builders' rating	H. P.	300
Per cent developed, *above rating*	Per cent.	19.2
RATE OF COMBUSTION PER HOUR.		
Dry coal actually burned per square foot of grate surface	Lbs.	18.84
Dry coal burned per square foot of water heating surface	Lbs.	0.44
RATE OF EVAPORATION PER HOUR.		
Water evaporated per square foot of water heating surface per hour from and at 212 deg. F.	Lbs.	3.73
Water evaporated per square foot of grate surface per hour from and at 212 deg. F.	Lbs.	158,15
ANALYSIS OF COAL.		
Moisture lost at 110 deg. C.	Per cent.	1.76
Volatile matter	Per cent.	22.34
Fixed carbon	Per cent.	68.70
Ash	Per cent.	7.20
SULPHUR	Per cent.	0.84
EVAPORATIVE POWER, one pound of coal on complete combustion will evaporate 13.86 *lbs. of water.*		

TEST OF HEINE BOILER AT DRUMMOND COLLIERY, WESTVILLE, N.S.

DATE OF TRIAL, JUNE 15TH, 1897.		
Duration of trial	Hours	8
Flat grate furnace		
Total grate surface	Sq. ft.	37.68
Total heating surface	Sq. ft.	1,450
Number of boilers in use		1
AVERAGE PRESSURE.		
Steam pressure in boiler, by gauge, per square inch	Lbs	75
Force of draught	In.	0.4
AVERAGE TEMPERATURES.		
Of external air	Deg	53
Of fire room	Deg	58.5
Of feed water before entering boiler	Deg	168
FUEL.		
Class of coal—Bituminous, Round, Main Seam.		
Moist coal consumed	Lbs	7,836
Moisture in coal	Per cent.	1.27
Dry coal consumed	Lbs	7,736
Total dry refuse	Lbs	905
Total dry refuse	Per cent.	11.7
Total combustible	Lbs	6,831
Dry coal consumed per hour	Lbs	067
Combustible consumed per hour	Lbs	854
BRITISH THERMAL UNITS.		
Number of heat units in a pound of dry coal by analysis	B. T. U.	13,402
Total heat units absorbed by boiler	B. T. U.	61,567,756
Heat units imparted to boiler per pound of dry coal	B. T. U.	7,958
Heat units imparted to boiler per pound of combustible	B. T. U.	9,012
Factor of evaporation for boiler		1.079
EFFICIENCIES.		
Efficiency of boiler based upon dry coal	Per cent.	59.37
Efficiency of boiler based upon combustible	Per cent.	67.24
WATER.		
Water actually evaported	Lbs	59,021

EVAPORATIVE PERFORMANCE.		
Water actually evaporated per pound dry coal......	Lbs......	7.62
Equivalent per pound of dry coal from and at 212 deg. F....................................	Lbs......	8.22
Water actually evaporated per pound of combustible	Lbs......	8.64
Equivalent per pound of combustible from and at 212 deg. F..................................	Lbs......	9.32
COMMERCIAL HORSE POWER.		
On basis of 30 lbs. of water from and at 212 deg. F., to steam of 70 lbs. gauge pressure per hour by boiler......................................	H. P.....	265.34
Horse power, builders' rating......................	H. P.....	200
Per cent. developed above rating..................	Per cent..	32.67
RATE OF COMBUSTION PER HOUR.		
Dry coal actually burned per square foot of grate surface...	Lbs......	25.66
Dry coal burned per square foot of water heating surface...	Lbs......	0.66
RATE OF EVAPORATION PER HOUR.		
Water evaporated per square foot of water heating surface per hour from and at 212 deg. F..........	Lbs......	5,48
Water evaporated per square foot of grate surface per hour from and at 212 deg. F................	Lbs......	211.24
ANALYSIS OF COAL.		
Moisture lost at 110 deg. C............................	Per cent..	1.76
Volatile matter..........................	Per cent..	22.34
Fixed carbon..................................	Per cent..	68.70
Ash..	Per cent..	7.20
SULPHUR......................................	Per cent..	0.84
EVAPORATIVE POWER, one pound of coal on complete combustion will evaporate 13.86 *lbs. of water.*		

Patent Fuel and its Manufacture.

By Chas. Archibald, Halifax.

Before entering upon the subject I have chosen for my paper, Patent Fuel and its Manufacture, I shall briefly refer to the changes that have taken place in the preparation of both anthracite and bituminous coals for the market.

The evolution of the anthracite coal breaker, revolutionized the coal trade in Pennsylvania. Previous to its introduction, the coal was shipped and sold as it came from the mine, and was broken up with hammers and screened by the consumer. The expense of breaking up the coal, and the great loss in fine coal which could not be used, led to the invention of suitable machinery, and the breaker was the result.

Innumerable devices were used, and improvement after improvement was made, until perfection has almost been reached in the modern breaker.

The great improvement in machinery for handling the coal and the introduction of improved forms of grates and furnaces has diminished the waste immensely, and enables the consumer to profitably use coal that was formerly consigned to the dirt dump.

It was not very long since chestnut was the smallest size of saleable coal, and all below that went to the culm dump, and improved machinery, grates and furnaces have added to the market list, pea, buckwheat and rice.

The machinery and appliances for handling bituminous coal, does not require to be so complicated, or expensive, as that used in the anthracite region.

Instead of requiring a breaker to break the coal, we require arrangements to prevent the coal from being broken, and to-day the profit of the colliery very materially depends upon how the coal is handled.

Many years have not elapsed, since there were only two kinds of coal known at the coal mines of Nova Scotia, round and slack ; the former passed over a screen, while the latter passed through longitudinal screen bars three quarters of an inch apart. All coal, except coal for gas purposes, had to be more carefully screened, and the coal mined at the colliery I managed, and also at other collieries in Cape Breton, was riddled in the mine by the miners and the slack or culm was left in the rooms, thus thousands of tons of good fuel have been inevitably lost. Later when the reduced duty on culm in the United States, and the erection of sugar refineries and other manufactories increased the demands for small coal and run of the mine coal, the practice of mining in Cape Breton was changed, and all the coal mined was raised to the surface, which was a decided advantage to the miner as well as an improvement to the mine, for every miner knows that the danger of gob fires from slack coal remaining in the rooms is always to be dreaded. The accumulation of slack on the surface for many years caused a slaughter of this coal in price, which sometimes ranged as low as thirty cents per ton, and some mine owners turned their attention to the screening of the slack and thus making nut coal. This making of nut coal has been for a long time carried on profitably at the Pictou collieries, but in Cape Breton it was not so successful; the coal in the Cape Breton seams made so much fine that when the nut was taken out considerably more than fifty per cent of unsalable coal was left.

To utilize the unsaleable duff was what induced me to start the first, and I think the only patent fuel plant, now in the Dominion of Canada.

Owing to several circumstances, but principally to the inconvenience of handling the fuel after it was made, I did not work the plant to any great extent, but my faith in the enterprise has never weakened, and I feel sure that in the near future patent fuel will be manufactured in large quantities in Cape Breton for shipment to southern ports as well as for home consumption. Great Britain exports a large quantity, in Cardiff alone about forty thousand tons is shipped per month. The great advantage of shipping patent fuel on long voyages to southern ports is that there is no danger of spontaneous combustion in the vessel, it does not slack or deteriorate like ordinary bituminous coal, it can be transported more easily and with less loss, and above all there is no danger of its taking fire when banked out.

I fear that I have wearied you in arriving at what I started out to do, viz: to give a very brief account of how patent fuel is manufactured, and the probable cost of making it. The plant I erected was Yeadon & Co's, Leeds, England.

The plant was capable of making five tons of fuel per hour, or fifty tons per day; this quantity was manufactured by one briquette machine, and the engine was calculated to run two briquette machines, so that by adding another machine I could at any time double the output.

In the manufacture of patent fuel various substances have been experimented on to cement the fine coal, but fire clay and pitch have been the most suitable. Clay made good looking and fairly durable briquettes, but the percentage of non-combustible matter in the briquettes condemned them, and pitch is now universally used.

The most necessary thing then in the manufacture of patent fuel is to obtain pitch of the right consistency, and more important still is to procure it at a reasonable price. The pitch is much harder than roofing pitch, and must be sufficiently brittle to pass through a disintegrating mill, by which process it is reduced to the size of common gunpowder.

When I commenced the manufacture of fuel in 1885, the only places on this side of the Atlantic where I could purchase suitable pitch were New York and Philadelphia. Glasgow, Scotland, supplies the preater part of the pitch used in England for the manufacture of patent fuel, and it can be purchased there now cheaper than in America.

Many experiments have been made in the use of the ordinary coal tar or pitch in liquid form for making patent fuel, and for aught I know some have been successful. When in London a few years ago, I had several interviews with an engineer of some prominence who formed a large company for this purpose; at that time there were some difficulties unsurmounted, but I never learned if he was ultimately successful.

The plant consisted of a coal elevator, a rotary screen for making nut coal, a pitch breaker, disintegrating mill, fine coal hopper and pitch hopper and automatic feed, an elevator to the super-heater, pug-mill and briquette machine; all this machinery was put in motion by a system of belting driven by a single geared engine 14 x 24 inches.

The manner of manufacture was as follows:—The ordinary slack that had passed through screens, constructed by placing longitudinal screen bars, one half inch apart, was dumped into a bin at the bottom of the coal elevator; the coal was elevated and emptied into the rotary screen; thence the nut passed into a car, and the fine or duff was conveyed by a chute to the fine coal hopper and feed with the pitch to the second elevator. The pitch after passing through the breaker was fed, to the disintegrating mill by a small boy, and after passing through the disintegrating mill was fed by the same boy to the pitch hopper. The automatic feed was so arranged that the percentage of pitch (about six per cent. of the coal used), was mixed with the coal and elevated to the super-heater, where it was carried along slowly by a screw feed and dropped by a chute into the pug-mill.

A super-heater is a cylinder heated by steam conducted from the boilers, which is super-heated by passing the steam through a furnace constructed for the purpose.

The steam is heated up to 300 degrees or more, Fahrenheit, and and the coal and pitch passing slowly through the heater is dropped into the pug-mill in a plastic condition.

The pitch and coal is fed automatically from the pug mill or mixer to a revolving wheel containing the dies or moulds, and in revolving is subjected to a pressure of two tons, and then forced out of the dies by a plunger—a perfectly pressed briquette.

The briquettes I made were 9 x 6 x 4½ inches, and weighed when made eleven pounds.

They are made in different shapes, like cannon balls, square, rectangular, and some for open fires are made in rings so that they will burn more freely.

Briquettes require a strong blast or draft, and are more lasting than ordinary coal. The rectangular shaped briquette such as I made, burned well in an open grate, but should be put on a good bright fire. They make most economical fuel in winter, and one briquette will last during a night, and gives out a good heat.

To run a patent fuel plant of fifty tons capacity per day, the number of men and boys required are: one capable men to look after the engine, belting and machinery generally, one man to look after the coal elevator and pitch breaker, one man to atfend the nut screen and look after the cars, one boy to run the disintegrating mill, one boy to carry the broken pitch to the disintegrating mill, and two to remove the briquettes from the plunger slide and place them on cars or stack them. When not shipping, I used a carrying chain run by a belt to remove the briquettes from the machine to a shed, where an extra boy is required to stack them.

Under ordinary circumstances twenty cents per ton should pay the labor of making the fuel.

The percentage of pitch varies from five to seven per cent. and valuing the pitch at eight dollars per ton, the cost for pitch would be about fifty cents per ton of fuel.

I have written this paper rather hurriedly and regret that I have no illustrations or plans of the Yeadon Patent Fuel plant, but I shall not feel disappointed if this brief and incomplete paper may induce more owners and managers to look into the manufacture of patent fuel seriously, as I feel sure that in the future it will be an important and profitable industry in this province.

MEETINGS.

Meetings.

MONTREAL, 3RD, 4TH, AND 5TH FEB., 1897.

The first Inter-Provincial Conference of Canadian Mining Engineers and Mine Owners, held under the auspices of the Federated Canadian Mining Institute, took place in the Club Room, Windsor Hotel, Montreal, on the 3rd, 4th and 5th February. There was a large and representative attendance at all the sessions.

The opening session was called to order at eleven o'clock on Wednesday morning, Major R. G. Leckie, M.E., Torbrook, N.S., President of the Federated Canadian Mining Institute, in the Chair.

SECRETARY'S REPORT.

Mr. B. T. A. BELL, Secretary, read the minutes of the meeting held in Montreal on the 10th Jan., 1896, which, on motion, were adopted. He also submitted the financial statement for the calendar year, showing :

RECEIPTS.

Sub. from Mining Society of Nova Scotia	$100 00	
do Gen. Mining Association, Prov. of Quebec	100 00	
do Ontario Mining Institute	100 00	
Sales Journal	21 20	
Mining Society of Nova Scotia on account of printing 1895 proceedings	25 00	
		$346 20
Loan Mr. A. W. Stevenson		150 00
		496 20

DISBURSEMENTS.

PRINTING—		
Estate Mortimer & Co	150 00	
Times Printing and Publishing Co	44 00	
Ottawa Printing Co	23 75	
		217 75
ENGRAVING—		
Etching Plate for Fergie's Paper	3 00	
Sabiston Engraving Co	9 28	
Grip Printing and Publishing Co	69 48	
		81 76
EXPENSE ACCOUNT—		
Postages, $42.07; Telegrams, $4.41	46 48	
Clerk and Stenographer	25 00	
Travelling, $4.00; Express Charges, $0.55	4 55	
Advertising, $15.00; Stationery, $14.55	29 55	
Bank Charges	4 75	
		110 23
Balance		86 46
		$496 20
ASSETS—		
Mining Society of Nova Scotia, outstanding printing 1895 proceedings	50 00	
Cash on hand	86 46	
		136 46
LIABILITIES—		
Mr. A. W. Stevenson, Loan	150 00	
Estate Mortimer & Co	210 00	
		$360 00

The above accounts have been carefully audited and found correct.

SIGNED, { S. J. SIMPSON,
H. W. DECOURTNEY.

With respect to the accounts, he would remind them that when the federation was made it was the intention, following the precedent of the Royal Society of Canada, which received $5,000 annually, to seek some assistance towards their work of publication from the Dominion Government. Everyone would realize the impossibility of carrying on the work of the Institute on a paltry contribution of $100 per society. During the year the Institute had published twenty-eight papers, which had been widely distributed, and would, doubtless, do much to attract attention to the resources of the country. A good deal of work had been accomplished in securing a more liberal interpretation of the law respecting the admission of free mining machinery. The statement of the Jenckes Machine Company, which for some time had been officially used at the ports of entry, had been withdrawn in favor of the statement of mining and smelting machinery made in Canada, compiled by the various societies in the federation. He had pleasure in submitting a copy for the inspection of any member who had not seen this statement. He also had interviews on behalf of several of their members respecting importations which had erroneously been charged for duty, and he was glad to say that in nearly every instance the Institute had succeeded in securing a remission of the duty. The law was still, however, open to some objection, inasmuch as aerial tramways were held not to be mining machinery. As these tramways were a necessity to the successful operation of many mines, notably in British Columbia, and as they were not manufactured in Canada, it was hoped that the representations of the Institute to have them placed on the free list would be successful. In accordance with a resolution passed at the last meeting of the board, there had been considerable correspondence with a view to holding an International Convention of Mining Engineers in Canada this year. The American Institute of Mining Engineers and the Federated Institute of Mining Engineers of Great Britain had each accepted a provisional invitation, but as the Iron and Steel Institute, which had also been invited, could not visit Canada this year, he thought it would be advisable to postpone this gathering to a more convenient date. He tabled the correspondence for the inspection of any member who would care to read it.

MR. JOHN HARDMAN, referring to the accounts and the statement of the secretary, said that the Institute had progressed and accomplished good work, but it was quite evident that the contribution from the societies was altogether too small to maintain the Institute in anything like an efficient condition. He confessed that the only way out of the difficulty was to ask the Dominion Government for a grant towards their publications. There were also one or two clauses in the constitution which might be amended with advantage.

MR. BELL suggested the appointment of a sub-committee to report on amendments.

MR. HOPPER thereupon moved that Major Leckie, Mr. W. R. White, Q.C., Mr. Hardman, Mr. Merritt and the Secretary be a sub-committee to report on suggested amendments to the constitution at the afternoon session. The motion was adopted.

A MINING MUSEUM FOR MONTREAL.

THE SECRETARY referred to the work of the Quebec Mining Association towards establishing a scientific and industrial collection of minerals, a reference library and reading room of mining literature, and a public record of mining undertakings in Montreal. The premises secured by the Association in the Macdonald building, on Victoria Square, were large enough for an institution that might be made something more national in its character, and it was a matter for consideration whether the Institute, representing as it did, the mineral interests of the country, should not make an endeavor to maintain and equip such a mining bureau or museum on national lines. If the Quebec Government gave $1,500 per annum, as they promised, it was not unlikely that the Federal Government would also contribute something to the maintenance of such an institution. The following letter reproduced in a recent issue of the Montreal *Gazette*, from the Hon. L. R. Masson, Minister of Militia and Defence, under date Ottawa, 20th December, 1879, in reply to a strong remonstrance from the Board of Trade and Corn Exchange against the removal of the Geological Museum from Montreal to Ottawa, would be of interest :—

Wm. J. Patterson, Esq., Secretary Board of Trade and Corn Exchange:

SIR—In reply to your letter of the 15th last, informing me that it was rumoured the Government intended placing the Geological Survey offices and Museum in a temporary building at the Capital, until suitable premises could be found, and requesting the members of the Cabinet from the Province of Quebec, in the name of the members of the Board of Trade and Corn Exchange Association, to use their influence with the Right Honourable the Premier and colleagues to stay proceedings—I beg to state that Parliament having decided that, on public grounds, and to ensure efficiency, it was necessary to remove the Geological Survey offices to the Capital, it now rests with the Government to adopt means for the early removal of those offices ; but I may inform the members of the Board, through you, that there is no intention of effecting that removal to a temporary building, as rumored. It will, on the contrary, when removed, be of a permanent character. *Relating to the Museum, which more particularly interests Montreal, the Government will do all in their power to meet the views of the Board of Trade and Corn Exchange, as expressed in your letter.* The collections of Montreal contain a very great number of duplicates ; those duplicates will no doubt be made available for the creation of the museum here in connection with the Geological Survey branch of the department ; *but the Government will, on account of the particular circumstances of the case, maintain* (during the pleasure of Parliament), *a Geological Museum in Montreal for the benefit of educational institutions of the city.*

Hoping that, under the circumstances, the above will be found satisfactory by the members of the Board of Trade and Corn Exchange, I have the honor, etc.

(Signed) L. R. Masson.

There was a very strong desire on the part of the business men of Montreal that such an institution properly equipped and managed should be established in that city—particularly now when the attention of its capitalists was being directed largely to mining investments.

Major Leckie—What we want is a commercial museum right here in Montreal directly in touch with the capital of the country. In talking the matter over with the bankers, I find that they are very desirous of having such a museum here. If we could only get such an institution established the business men of the city would make very good use of it.

After some discussion it was resolved to leave the matter in the hands of the Council to arrange for an early interview with the Dominion Government, with a view to securing suitable assistance towards carrying the projected bureau into effect.

ADVANCE PUBLICATION OF PAPERS.

Mr. White, Q.C.—Before closing I would like to submit a resolution with reference to procedure. I beg to move, "That all papers hereafter proposed to be read at the meetings of this Institute shall be transmittd to the Secretary at least ten days before such meeting, and that the Secretary cause such papers to be printed and distributed among the members of the Institute on the opening of the meeting."

My reasons for this motion are that a great deal of time is wasted in reading papers. Necessarily a gentleman dealing with a subject of prime importance to the interests assembled here puts his views sometimes pretty lengthily, and it takes up a good deal of time in reading. I am quite sure that when a paper is read here for the first time you are unable to at once judge whether it requires discussion, and how it shall be discussed. Now the result of my motion will be to give an opportunity for that; it will give an opportunity for every member to take that paper and study it, and he would then be able to discuss it intelligently here. I think the papers can then be taken as read, and we can do the business in two days instead of three. An objection of course might be made as to the cost.

Mr. B. T. A. Bell.—I have veay great pleasure in seconding Mr. White's resolution. At the same time the whole matter resolves itself into a question of cost. Some allowance must be made for us at this our first meeting. However, with respect to present programme of papers, all of which it is impossible to read at this meeting, I may say that they will be printed in full in the current issue of *The Canadian Mining Review*, within the next two weeks. The Mining Society of Nova Scotia meets on the second Wednesday of next month, and the Ontario Mining Institute is to meet at Toronto about the same time, so that most of our members will have an opportunity of discussing any of them at these meetings. I quite sympathise with the movement to place papers in the hands of the members in advance of a meeting. I think it would enliven and brighten up the discussions. I hope that by the time we meet next year we shall have sufficient funds to do things up as we would like, but give us a chance ; we are young yet.

DR. PORTER.—I have had some little experience in connection with the American Society of Mining Engineers, and I think the advantage is so great that if the Institute ever tries the experiment it will feel satisfied that even at considerable additional cost it is worth that cost. The chief value of a paper is the discussion ; and the discussion of a paper cannot amount to very much if it is made impromptu immediately after it has been read. A very important feature of many papers is the figures, and I think the discussion would not only be doubly but ten times as valuable as it now is if we had the papers in advance. It would also bring into the discussion men who do not touch it at all now.

MR. WHITE'S motion was carried unanimously.

INVITATION TO VISIT McGILL AND THE WORKS OF THE ROYAL ELECTRIC COMPANY.

MR. BELL here announced that the Governors of McGill University extended a hearty invitation to the members of the Institute to visit the Laboratories and the Redpath Museum, and that Mr. Brown, manager of the Royal Electric Company, invited any of the visiting engineers who might have time to visit their works.

The meeting adjourned until the afternoon.

PRESIDENT'S ADDRESS.

The members reassembled at three o'clock :—

MAJOR LECKIE.—The effort to bring together in one federal body, the several Mining Societies of our different provinces, is fully justified by the results which we now see. Around us here are met men from every province of the Dominion—Engineers of high technical training and extended experience, explorers, who have shown pluck and endurance in their tireless search for croppings ; miners, who have developed the discoveries, and metallurgists, who have extracted the refined metals from the ore.

Mining, in almost every portion of the globe, is at the present day exciting more attention than any other industry, and the production of almost all kinds of mineral was greater last year than has ever before been known.

Of all the industrial arts which contribute to the progress and welfare of mankind, we may claim the most important place for mining and its handmaiden metallurgy.

Although the art of mining may refer only to the winning of ores and minerals, and their preparation for further treatment by the metallurgist, yet within the scope of this and other similar societies are comprehended geology, mineralogy, civil and mechanical engineering; while metallurgy rests on chemistry, physics and mechanics as the foundation of the sciences.

The importance of our Institute in a scientific and technical way is therefore obvious.

The reasons for organizing such an Institute as ours will not be seriously called in question in the present day, by any engineer or professional man. Every profession has its individual and perhaps exclusive society. Every branch of industry and commerce has its organization, and craftsmen and laborers vigorously maintain their own unions. Our Institute, as you know, is a federation of Provincial mining societies, which in their own limited spheres have been of great service to their members, both from a technical commercial and legislative point of view, besides promoting a spirit of social good-fellowship.

This Federated Institute will carry the work of these Societies to a wider sphere, extending from ocean to ocean, and discuss matters from a broader point of view.

The Provincial Societies will still have their own immediate affairs to look after, which in many respects are practically of greater importance.

The titles to lands, conditions and terms of mining leases, laws regulating the workings of mines and employment of labour, all come within the sphere of the Provincial Legislature, likewise local taxation, the encouragement and regulation of technical education and other such matters.

The Canadian Mining Institute will, I take it, devote itself more to technical and scientific matters, as the syllabus now before us shows. It contains a list of papers of the highest interest and practical value, which would do much credit to any similar association in the world.

In the discussion of the papers everyone should take an active interest. Ideas and opinions are evolved of much value, being the result as a rule of either individual experience or research.

Practical men are not often given to writing, but such discussions frequently elicit their views, which are of the greatest value, and expressed in the clear, fresh and terse language of the thoughtful worker. It is like the excitement of the dynamo; of mind upon mind, or as the wise king of old said: "As iron sharpeneth iron, so the countenance of a friend brighteneth that of his neighbour."

Then there are the advantages of personal acquaintanceship formed, of exchange of experience, and information obtained upon special subjects, which cannot be overrated. The remarks of Sir Thomas Kitson on a similar occasion are called to mind:

"It is well that we should meet thus, eye to eye and voice to voice, to discuss the interests and scientific aspects of the great industry which absorbs us. It is thus we learn how much has been accomplished by persistent and intelligent labour, how much remains to be achieved, and how, by free exchange of ideas and productions, friendly understanding is promoted and personal acquaintance is built up. Through such orderings we are convinced that Providence has designed to wind the silken chain of commerce round the world."

The papers already published by the Institute are but the beginning, I trust, of a series of volumes, which will embody technical and practical information of the highest professional value.

I repeat that mining and metallurgy form the basis of human progress and civilization.

Sir Lowthian Bell has well said, "That with the exception of air and water, it is open to question whether there is any form of matter which the human race could less easily spare than iron. Without this metal for an anchor, or steel for a compass, the adventurous navigator could never have crossed the wide Atlantic," and as I once heard the Hon. Abraham Hewitt, of New York, at the meeting of the British Iron and Steel Institute, in 1891, say of Sir Henry Bessemer, that "We can trace, therefore, directly to the Bessemer invention the ability to reduce our national (United States') debt, and finally to pay off the outstanding debts at maturity. It ought to secure for him the gratitude of every American citizen, and I am glad to have the opportunity on this occasion, to bring this obligation to the notice of my countrymen, whose homes he has multiplied, whose country he has developed, whose burdens of debt he has lightened, and whose progress in all the arts of civilization he has placed upon a basis as durable as the material with which his name has ever been associated."

To her coal and iron resources, with the skill of her miners and metallurgists, Great Britain is indebted for the marvellous development of her manufactures and commerce, and they still enable her to remain mistress of the seas, more effectually than when her ships were of English oak. At the present day, when our thoughts are all running after the precious metals, it is well to bear in mind that iron is still the most precious of all metals for the comfort and progress of mankind.

The systems of banking and the world's exchange are based upon the fruits of our labours. What would merchants and bankers do without us? The miser, as well as the Minister of Finance, alike feels safe with his hoarded gold. Our Chancellor of the Exchequer feels cheerful when the vaults of the Bank of England are bursting with fifty million pounds sterling. Last year our fellow-labourers added to this exchangeable wealth of the world, over two hundred millions of dollars, weighing over four hundred tons of refined gold. Yet the rapacious maws of bankers and financiers are still crying for more. As the greatest individual producer of this enormous wealth, the British Empire still leads, and this lead is likely to be increased further by the development of the limitless resources of our Dominion. The Eastern Provinces will increase their supply, and Western Ontario has a brilliant future, but it is to our domains on the Pacific slopes that we look for a rapid addition to the yield of gold as well as silver. Progress there, for many years, was slow, but within the last twelve-months it has been marvellous. We look with the deepest interest and fraternal pride upon the labours of our professional brethren in British Columbia, and trust that their brightest hopes will be realized, both in the interests of the Province itself and the noble Empire to which we belong.

It is gratifying to have so many students present at our meeting. They come from an atmosphere of theory and the laboratory of scientific experiment, to rub shoulders with the hardy explorer and those engaged in the active pursuits of the profession.

In Ontario there are two institutions for technical education of great excellence, and in this city you have a university equipped for scientific research and technical application, unsurpassed in the world, thanks to the unstinted generosity and public spirit of one whose name should always be held in high honor by the profession, Mr. W. C. McDonald (applause). The means are given to acquire what John Milton considered a complete education. "A complete education," he said, "I hold to be one that prepares a man to perform wisely, skilfully, magnanimously, all duties, public and private, in peace and war."

Here you will meet the hardy pioneers of our industries, men of unflagging courage, possessed of "sinews of steel and muscles of iron." These are the men who, forming the advance guard of civilization, have conquered the wilds for humanity, who in the country south of us have added new States to the Union, and who within the British sphere have developed new colonies, almost continents, to enrich and strengthen our world-wide Empire. (Loud applause.)

The following papers were then taken up at this session :—

(1) The Economics of Joint Stock Companies and the laws relating to their incorporation, by Mr. J. Bawden, Kingston.

(2) The Question of Initial Payments on Bonds, by Howard West, A.R.S.M., New Denver, B.C.

AMENDMENTS TO CONSTITUTION.

Mr. W. R. WHITE, Q.C., on behalf of the Committee, submitted the following suggested amendments to the Constitution and By-Laws :—

Sec. I.—The organization shall be named the *Federated* Canadian Mining Institute.

Sec. IV.—To read : The affairs and business of the Institute shall be managed and controlled by a Council consisting of the Presidents of the Societies in the Federation and one member for every forty and fraction thereof in good standing in their respective societies, to be elected annually by each such society, *said members to hold office until their successors are elected. A majority of said Council shall constitute a* QUORUM.

Sec. V.—The Council, *at their annual meeting,* shall elect a chairman and a secretary-treasurer, the latter to receive such remuneration as may be determined by it ; *such* meeting shall be held immediately after the annual meeting of the Institute.

Sec. VI.—* * * the funds of the Institute shall be received by him (the secretary-treasurer) and be deposited in his name, as secretary-treasurer, at a bank approved by the Council.

Sec. VII.—*All payments on behalf of the Institute shall be made by the secretary-treasurer upon the approval of any member of the Council.*

Sec. IX.—The Societies of the Federation shall each pay an annual subscription towards the expenses of the Institute of such an amount as may be determined upon *by the Council,* but the contribution from each Society shall at no time exceed in amount the sum of three dollars *for each member of such society.*

Sec. X.—deleted.

Sec. XI.—The Annual General Meeting of the Institute shall be a united meeting of the various Societies in the Federation ; it shall be held on the first Wednesday in February, commencing at eleven o'clock in the forenoon of said day, or at such other time as the Council may determine.

Sec. XIII.—Contributors of papers shall be entitled to twelve copies of any paper presented by them and published by the Institute. Additional copies shall be sold at such price as the Council may determine.

Sec. XVI.—The Council may accept papers or other documents from persons who are not members of the Institute and allow them to be published in its proceedings.

Sec. XVII.—Any amendment or alteration to the Constitution or By-Laws of the Institute may be made by the majority of the members of Council, such amendments to be in force until the next general meeting of the Institute when the same must be ratified by a majority of the members of the Institute present. Notice of such amendments must be sent by the secretary to every member of the Institute at least two weeks prior to such general meeting.

Mr. White moved, seconded by Mr. Hardman, that the report of the Committee be adopted. Carried.

The afternoon Session then adjourned.

EVENING SESSION.

The members re-assembled at eight o'clock.

Mr. W. Hamilton Merritt, A.R.S.M., Toronto, exhibited and explained a very complete portable field outfit for prospectors, manufactured by Messrs. Lyman & Sons, Montreal, which could be used for determining, to some extent, the value of ores and minerals in the field.

Thereafter Dr. John B. Porter, Professor of Mining Engineering at McGill College, read a brief paper on "The Responsibilities of the Mining Engineer."

ONTARIO MINING ACT.

The Secretary read the following letter :—

Sir,—As the Provincial Legislature is about to convene in the near future, I have taken the liberty of calling your attention to a deficiency in our present Mining Act. There is nothing in it which makes provision for the working of mineral properties when the minority prospector or other interest will not be party to or accept any reasonable proposition for the sale or working of such minority interest. A number of properties up here are lying idle for this reason. It would be to the benefit of the country if a clause were inserted in the Act making it compulsory for the minority interest to accept the same *pro rata* terms should the majority dispose of their holdings. Or in the event of the majority interest working the property that the minority be compelled to contribute their share for the expense of opening up, proving and equipping of the property, if results warranted it. Some of our prospectors and others holding very small interest in properties have been able by their extravagant demands to keep properties tied up and undeveloped which would otherwise have been opened up and tested. The end in view is simply that such provision be made as will prevent this and at the same time protect the minority interest. It would seem as though this could be accomplished if the Government would appoint one or more umpires to rule on such matters whose decision would be final and prompt. In such cases at present there is no way of settling such matters unless the courts are resorted to. This is expensive, and much valuable time is lost before a final ruling is given.

In view of this can we ask you to bring this to the attention of the Canadian Mining Institute that the matter may be forcibly presented to the legislature at its coming session, and oblige.

Yours, etc.,

R. W. DE MOREST.

Sudbury, 13th January, 1897.

MR. BAWDEN.—There is also a mode of dealing with the difficulty which arises where there is an obstinate minority, by means of arbitration. Parties who think they are not properly dealt with may have arbitrators appointed. The minority nominate one arbitrator and the majority nominate theirs, and the umpire decides the difference. It is quite practicable to meet the difficulty in this way.

MR. W. R. WHITE, Q.C.—I think he means to deal with these properties which are held in the hands of the original owners and have not been changed into joint stock companies at all. It seems to me that the laws of Ontario could be made use of by simply letting those who desire to sell apply to the court. I think he referred to the Joint Stock Companies Act.

MR. BAWDEN.—To the mining Department Act of British Columbia.

MR. WHITE.—We have no such law in Ontario.

MR. BAWDEN.—No; but such legislation is required that would meet it.

MR. WHITE.—It would seem to me to be a very hard thing that any person who had any interest in the property could be compelled to open up a mine if he did not wish to do so. I think the law as it now stands deals with it the same as any other real estate in the country, which I think would be quite sufficient in a matter of that kind. The only way to do is to apply the law of the country as it now stands. I happen to have had some experience in nickel property at Sudbury.

DR. GILPIN, Inspector of Mines, Nova Scotia.—The only remark I can make on the subject is that in Nova Scotia when that question came up we concluded that the best way to prevent any misunderstanding was to have a short Act passed for the partition of mining properties, leaving it to be dealt with in the same way as the partition of lands in dispute, and so far this seems to be satisfactory.

MR. BELL.—Under the Ontario Act there has been a tremendous blanketing of lands by speculators who are blocking up large areas and who undoubtedly tie up the country to the prejudice of its development.

MR. WHITE.—That does occur in the Sudbury district. I know that a very large corporation there did so not for the purpose of working the property but for the purpose of shutting out competition. That of course might be dealt with in an entirely different way, perhaps by preventing any mining corporation from holding more than a certain number of acres of land. That is the only way in which it could be dealt with, and it is quite proper that should be done. Land companies, for example, are dealt with in the same way. A land company cannot acquire land on which an ordinary mortgage is held, and hold it more than five or seven years without dealing with the property or without selling it, and if the same law existed with regard to mining corporations, then they could not hold the land longer than a certain number of years without working it ; that would cover the point. I know that what Mr. Bell says with regard to the blanketing of land is true. Large properties have been secured in the Sudbury district without doing or intending to do anything.

MR. BAWDEN.—According to the Joint Stock Companies Act, if the property is held for more than seven years it becomes forfeitable to the Crown.

MR. WHITE.—That covers the whole thing.

The discussion then dropped.

The following papers were then taken up :

"The Advantages of Compressed Air," by James F. Lewis, Chicago.

"The 150 H. P. Hydraulic Air Compressor erected for the Dominion Cotton Mills Co., at Magog, Que.," by C. H. Taylor, M.E., Montreal.

"Louisburg : Its importance as an Imperial Coaling Station," by Wm. Blakemore, Glace Bay, C.B.

"The Responsibilities of the Mining Engineer," by Dr. John B. Porter, M.E., Montreal.

"Notes on Underground Photography" (illustrated), by Mr. George R. Mickle, M.E., Sudbury, Ont.

THURSDAY MORNING SESSION.

The meeting convened at eleven o'clock, Major Leckie, President, in the chair :

The following papers were read and discussed :—

"Notes on the Western Ontario Gold Fields," by Dr. A. P. Coleman, Toronto.

"Gold Quartz Mining in Canada and Victoria, Australia," by Dr. A. R. C. Selwyn, C.M.G., Ottawa.

THURSDAY AFTERNOON SESSION.

The President took the Chair at three o'clock. His Excellency the Governor-General was present during the whole of the session.

The following papers were discussed :—

"Notes on some Mining Districts in British Columbia," by Mr. John E. Hardman, S. B. M. E., Montreal.

"The Gold Bearing Lodes of Cayoose Creek, by Mr. G. F. Moncton, M.E., Vancouver, B.C.

"The Utilization of the Mill Refuse and Peat Mosses of the Ottawa," by Mr. Ernest A. Sjostedt, M.E., Bridgeville, N.S.

"Notes on the Mining of Low Grade Ores in Nova Scotia," by Mr. F. S. Andrews, Country Harbor, N.S.

FRIDAY AFTERNOON SESSION.

The meeting convened at three o'clock. Mr. H. A. Budden, Intercolonial Coal Co., in the absence of the President, being called to the Chair.

EARLIER PUBLICATION OF THE GEOLOGICAL SURVEY REPORTS.

COL. RAY (PORT ARTHUR).—I live in that portion of the country where the Autumns come along somewhat early, and I have found that the reports of the Geological Survey Department at Ottawa were not of that benefit that they otherwise would be if issued earlier in the season. The prospectors start out early, about the time the snow gets off and the mosquitos get on, and they have not the opportunity of reading any of the reports until the next winter. I want to see if this Institute can do anything to induce the Department at Ottawa to get out their reports earlier. I am aware that possibly the staff may be somewhat short-handed and perhaps they may be overworked. It looks to me that if a representation made by an organization like this could induce the department to increase the staff so as to enable them to issue their reports at a time of the year when it would most benefit these prospectors it would be a good thing. I left home on the 5th of January and up to that time I had not received the report from the Geological Department—I mean the report for 1895. I was making an enquiry yesterday and I found that the report had been issued just recently.

DR. G. M. DAWSON.—I am quite sure we are very much pleased to have any suggestions in reference to these reports. I might explain that we have different kinds of reports. There is the Summary Report. That is the only report which, according to our Act, has to be closed as soon as the new year opens. It is all in type now, and as soon as it is issued it will show the work up to the close of the calender year. I think this is about as prompt as it can be expected to be issued. I think that the statistical report which contains the figures of the production of the year—that is the summary statement for 1895—was issued in March last; at least the main figures of it were at any rate. Then in regard to the third series of reports, which are of a more permanent class; they are issued just as they are finished. These reports are more or less of a finished character, and are supposed to have more of a permanent form. I think perhaps the figures with regard to mineral production might be issued earlier. I know the Summary Report of 1895 was issued last winter. It could not have been later than March, and as summing up the work I think it is of use to the prospector, who can study it in his winter quarters before going out in the spring.

Col. Ray.—It looks to me as if the Doctor had made out a very good case, but perhaps those who have been in the habit of sending in reports could do so earlier. I accept the Doctor's explanation, and I believe the Summary Report is just what we want, and if we could get it as promptly as we were told they were issued last year it would be all right.

PROVINCIAL TOPOGRAPHICAL SURVEYS.

Dr. Dawson,—Now that the Federated Mining Institute has been established, I hope it will turn its attention to those matters which require attention sooner or later. I hope it will help us a little in the way of topographical surveys. It is surprising that there is not a proper survey of the older provinces. I do not know whether in Ontario or Nova Scotia the Government have ever done any surveying, except the running of cadastral lines, etc. There is no doubt that a proper topographical survey is much needed.

Dr. Gilpin (Halifax).—I had the pleasure of intimating to Dr. Dawson's predecessor the methods employed in making a topographical survey in the Province of Nova Scotia. The Geological Survey did begin, and worked from Halifax to the eastward, and made a very excellent map indeed, and I believe a very accurate one. The cost of that survey has been saved to the country at many times over. It has been shown that it is not only of a theoretical value from a prospector's point of view, but it has practically been the foundation of operations for domestic life in the districts there.

The Chairman,—Before leaving the subject which Col. Ray has introduced, I may say that I remember that very many years ago—I speak of 35 years ago—the mining men appeared to be in closer touch with the survey than in the past. The reports were sent to the mining men then, and I should like very much if those conditions existed now.

Doctor Coleman,—There is great need for a really good topographical survey of the older provinces. In the more thickly settled parts of the country we should have a good topographical map. Such a map would be of immense advantage, not only to the mining engineer himself, but also to the laying out of railroads, etc. The Geological survey might combine in such a matter with Ontario and the other provinces, making use of the information already acquired.

THE CHAIRMAN,—With Nova Scotia especially.

DR. GOODWIN,—I think Ontario is one of the most backward in this respect. The Ontario maps are made and the reports sent in by land-surveyors. There ought to be something like a good topographical survey. There is no doubt about that.

MR. LIONEL H. SHIRLEY,—I think it should be a direct trigonometrical map, as nothing else will take its place. It is not a too expensive operation for the Government to undertake, and if once it is laid down all the rest will fit in accurately afterwards.

SUCCESSFUL GOLD MINING IN NOVA SCOTIA.

THE SECRETARY,—I rise, Mr. Chairman, to correct an erroneous statement in one of the evening papers, from which one would infer that gold mining in Nova Scotia was not a success. I need not say, in this company, that such a statement is wholly untrue (hear! hear!). In almost every instance where ordinary business prudence has been exercised in the selection of a property or in the choice of a manager, success has been the result, and not failure. In many places the mines have been equipped with plants that will stand comparison for effectiveness and economy with those of any other gold producing country in the world. Among other successful mines at present yielding handsome returns to the proprietors, I might mention the Golden Lode at Mount Uniacke, the New Egerton at 15 Mile Stream, the Richardson at Country Harbour, the Libbey Mine at North Brookfield, the Bluenose at Goldenville, the Modstock at Stormont, the Tuoquoy at Caribou, and many others. The easy means of access, and consequent convenience of personal examination, the low cost of working, the cheapness of labour, fuel and supplies, the permanent nature of the deposits as inferred from their geological structure, are all good and sufficient reasons why capital should find remunerative investment in the extensive area of gold measures of Nova Scotia. (Applause.)

MR. A. A. HAYWARD, MOUNT UNIACKE, N.S.,—I should like to say a few words with regard to Nova Scotia gold mining. I came to the province about 15 years ago, and the opinions that I formed were that Nova Scotia possesses exceptional advantages for mining. I know of one mine which has been successfully worked down to a depth of 900 feet, and I believe there are other mines there working down to the same depth. It seems to me that

Nova Scotia offers as many advantages for mining as any other part of the Dominion. I have also heard it said that the titles in Nova Scotia were somewhat defective, but during my time in Nova Scotia there has been comparatively little litigation in comparison with other countries, and in no instance has it been from imperfection of titles, but from people attempting to break titles. I have mined successfully there for 15 years, with very good results. (Applause.)

THANKS TO THE INTERCOLONIAL RAILWAY.

THE SECRETARY:—On behalf of the Institute, and particularly on behalf of those of our members who have travelled to this meeting from the Maritime Provinces, I desire to express our cordial acknowledgment of the courtesy of the management of the Intercolonial Railway, in placing exceptional facilities for travelling over their line to our meeting; not only were exceedingly low rates given to our delegates, but everything has been done by the passenger department to make things pleasant for our Nova Scotia friends on so long a journey. Mr. Price, who has looked after the interests of our Nova Scotia delegates, is particularly deserving of our recognition for his admirable efforts on their behalf, and I have much pleasure, therefore, in moving that the best thanks of the Institute be conveyed to him. The motion was carried unanimously.

ELECTION OF OFFICERS FOR 1897-98.

Mr. George E. Drummond, President of the General Mining Association of the Province of Quebec, was unanimously elected President for the ensuing year, and Mr. B. T. A. Bell, Editor of the *Canadian Mining Review*, Secretary-Treasurer.

Mr. Penhale, seconded by Mr. Hooper, moved that a hearty vote of thanks be tendered to the Secretary-Treasurer for his very efficient services during the year. Carried.

The meeting then adjourned.

MEETING OF THE FEDERATED BOARD.

A meeting of the Council of the Institute was held immediately after, Mr. George Drummond, President, in the chair. After some discussion of the affairs of the Institute and its work during the ensuing year, the following resolution, moved by Mr. R. T. Hopper, Montreal, seconded by Dr. W. L. Goodwin, Kingston, was adopted:—

Resolved:—That the Secretary-Treasurer be authorized to draw upon each of the Societies in the Federation for the sum of $74.55, to liquidate outstanding liabilities for the calendar year 1896; and that the sum of two dollars per capita be assessed, payable quarterly, to cover operating expenses for the ensuing year.

The meeting closed at seven o'clock.

ANNUAL DINNER.

The first annual dinner of the Federated Canadian Mining Institute was held in the Windsor Hotel, Montreal, on Thursday evening, 5th February, and was in every sense a pronounced success. Previous to the Dinner, His Excellency held a Reception, after which Piper Carruthers of the Royal Scots played the party to the banquet hall. Covers were laid for 160. Major R. G. Leckie, M.E., Past President of the Federated Institute, presided, having on his right His Excellency, Lord Aberdeen, the Hon. Sydney Fisher, M.P., Minister of Agriculture, Ottawa, Hon. Thomas Chapais, Commissioner of Colonization and Mines, Quebec, Dr. George Dawson, C.M.G., Director of the Geological Survey, Ottawa, and Mr. Neve, A.D.C.; and on his left the Hon. W. S. Fielding, Minister of Finance, Ottawa, Dr. Anderson, United States Consul General, Montreal, Dr. Peterson, Principal of McGill University, Montreal, the Rev. Dr. Barclay, Montreal, Dr. A. R. C. Selwyn, C.M.G.. late Director of the Geological Survey of Canada, Ottawa, Hon. Peter White, late speaker of the House of Commons, Mr. John McKergow, President of the Montreal Board of Trade, Mr. T. J. Drummond, Montreal Car Wheel Co., and Mr. B. T. A. Bell, Secretary of the Institute. Among other guests noticed were Dr. Gilpin, Deputy Commissioner and Inspecor of Mines for Nova Scotia, Mr. Goff Penny, M.P., and Mr. M. J. F. Quinn, Q.C., M.P., Montreal, Dr. A. P. Coleman, Provincial Geologist for the Province of Ontario, Toronto, Dr. W. L. Goodwin, Director, Kingston School of Mining, Kingston, Dr. John Bonsall Porter, M.E,, McGill University, Montreal, Lt.-Col. Caverhill, Montreal, A. W. Fleck, Secretary Canada Atlantic Railway, Ottawa, F. Aug. Heinze, British Columbia Smelting and Refining Co., Trail, B.C., W. H. Kelson, Canadian Pacific Railway, Montreal, W. H. Price, Intercolonial Railway, Moncton, N.B., Wm. McMaster, Montreal Rolling Mills Co., Montreal, J. W. Peck, Peck, Benny & Co., Montreal, Donald McMaster, Q.C., Montreal, and others.

The Rev. Dr. Barclay said Grace. During the dinner, which was served in the Windsor's best style, a number of choice selections were rendered by the orchestra. After dinner the Chairman gave the toast of "The Queen," which was loyally honored, the company singing right heartily the National Anthem.

HIS EXCELLENCY THE GOVERNOR GENERAL.

The Chairman briefly and appropriately proposed the toast of "His Excellency the Governor-General," the company responding with "For He's a Jolly Good Fellow."

His Excellency Lord Aberdeen,—upon rising to respond, received an enthusiastic reception. After the ovation had subsided he said:—"Mr. Chairman and gentleman, I am very much impressed and very much touched by the cordial and kindly manner in which this toast has been proposed and received. As I was listening just now to the company joining so heartily in singing the National Anthem, I could not help thinking that I had never heard it better rendered, and I also thought that when the time comes to return to the old country one of the things I would record in regard to Canada would be the enthusiasm with which throughout the length and breadth of this fair Dominion that noble song is honored (applause). Of course I do not admit that in England they are any the less loyal than in Canada, but they do not always succeed in expressing their loyalty and feelings in such good time, such good tune, and in such good heartedness as we do in Canada. Let me also say that afterwards, when another song was rendered, that I thought I never heard that song, for effect and genial feeling, better rendered. I listened, though I did not join in any personal reference of course. Mr. Chairman, I can assure you that I am glad to be here. I am here in a twofold capacity: first, in an official capacity, and it is in that capacity that you have recognized and honored this toast to the person who for the time being has the privilege of representing our Most Gracious Sovereign. I am also here in the capacity of Patron of the Federated Canadian Mining Institute. It is a very good rule when one is asked to undertake any office, to enquire what are the duties of that office, but I confess that I entirely forgot on this occasion to make such enquiry. I, of course, accepted at once the privilege of being named its patron. (Applause.) However, I have discovered that one of the duties of this office was to enjoy an uncommonly good dinner in uncommonly good company. (Applause.) That duty I will always be willing to undertake on every occasion. But the reason why the Governor General is askad to be the patron of this organisation, is because your operations and influence covers the whole of this wide Dominion, and therefore you look to the person who happens to occupy a position of a representative character, technically the head of the community, and ask him to be connected with an association of this kind, representing as it does in a very comprehensive, in the most far-reaching manner, the interests of the country at large. (Applause.)

The present occasion is one of special interest and importance. Mining research and mining enterprise are no new things in Canada, but recently the various societies and organisations devoted to this undertaking in different parts of the Dominion have been federated and centralised, and the present is the first general gathering since this desirable arrangement was effected—desirable not only in regard to the advantage which it may be expected to produce in a direct manner, but also because any well considered movement in the direction of co-operation on the part of different bodies has a helpful influence. (Applause.) We are all ready, and with good reason, to praise and magnify the greatness and the resources of our country; but it is possible that when we have to take action in any particular direction there is a tendency to allow what is supposed to be for the advantage or the magnification of our own particular province or locality to obscure our view as to benefit of the community in a wider, a national sense. (Hear! Hear!)

There is another reason why this Federated Mining Institute should be regarded with public satisfaction and approval. We all know that when any special development is attracting attention, there are plenty of people who will be on the alert to secure an advantage for themselves,—as the phrase is, to turn a penny,—but not altogether, perhaps, an honest penny, (hear, hear,) and in no form of enterprise is their greater liability to this than in that of mining. Nor is it very easy to see how this can be prevented. As long as there are "Simple Simons" going about, there is likely to be a "Pieman," to deal with them. And in case the old rhyme is not sufficiently familiar to all, I may explain that I am referring to what is sometimes described as the "booming" system. (Hear! Hear!) It is marvellous how ready many people seem to be to seize the first bait that is offered; and of course the harm is done not only to individuals but to interests as a whole. May it not be expected that an institution such as this, combining scientific knowledge with a stable position, may afford opportunities for spreading sound information, which will be of practical benefit, especially to "Simple Simon," if he will take the "trouble to apply for the needed information?" (Applause.) At any rate it is quite evident that one of the purposes which the Institute places before itself is the checking of "booming" and artificial inflation in relation to mining speculation, and more particularly the prevention, as far as possible, of fraudulent or misleading prospectuses. (Loud applause.)

I think the Institute and the public may be congratulated upon the nature of the proceedings of the present convention. I have had the advantage, as one of the lay members of the assembly, of listening to some of the papers and discussions of to-day. These had reference specially to mining in a portion of the Dominion which has for some time been attracting particular attention, not only throughout Canada, but in different parts of the world. I refer, of course, to British Columbia,—and it seems to be always improving on further acquaintance. (Applause.) It is perhaps natural that I should have been particularly glad to hear the papers regarding British Columbia, because while of course to the Governor General every part of the Dominion is in one sense of equal importance and interest, yet as an individual I cannot be wholly unmindful of the fact that in British Columbia I happen to have a nest—I do not mean the Crow's Nest (laughter)—I should be glad for some reasons if my habitat were there (hear, hear,)—but a retreat, devoted not to mining but to horticultural enterprise, where, as my friend the Lieutenant Governor of Quebec kindly observes, the Governor General and his family are transformed into jovial farmers. Our joviality on a recent occasion was somewhat marred by an untoward accident of fire, which consumed part of our premises, namely, the office ; and I refer to that, in itself, somewhat small incident, because I observe that subsequently concern and anxiety were expressed in other parts of the Dominion, as to an apprehended injury to public interests, by the supposed destruction of State documents, etc., and therefore I wish to reassure anxious minds upon that point. It is true that there was a piece of Government (i.e., British Columbia) property in the shape of a telegraphic cypher code in the office ; and when the alarm was given I sallied forth, bent upon valorous deeds in rescuing this article ; but a voice checked me,—a voice from that quarter which has hindered so many a man from rash and ill-considered action, though afterwards he is apt to imagine that it was his own prudence and foresight which protected him ; the voice of Lady Aberdeen, "Remember the ammunition !" (laughter and applause.) It is marvellous what a quenching effect upon zeal in the matter of extinguishing a fire is produced by the thought of gunpowder stored in the building. In this case it was cartridges,—not cartridges for explosive purposes in mines, but for the chase ; and we realized the danger that would have been incurred by entering the building, when a thousand or so of cartridges stored in it began to discharge themselves. The effect was remarkable ; it would have made a splendid Fourth of July celebration in the United States. (Laughter and applause.) But I should perhaps explain that that ammunition did not belong to me—certainly not to the Government—but to my friend and Secretary, Captain Sinclair. I am sorry to say that he was the chief sufferer as to more important matters, for many of his own private papers were destroyed, and a good deal of extra work was occasioned to him by the necessity for re-copying other documeuts ; but, as I indicated before, no origiual Government papers of any importance were lost.

Having referred to Captain Sinclair, I may be pardoned for going on to remark that the election of that gentleman to the Imperial Parliament as Member for one of the largest and most important counties of Scotland will have been observed with interest by not a few in Canada. (Applause.) His departure from this country will be a loss, a very real loss, to those with whom he was immediately associated, but it will be something more than that ; for the usefulness of the Governor General's Secretary, when the post is occupied by such a man, is something far beyond the sphere of personal convenience—it is of public advantage.

I merely wish to take this opportunity of saying that Canada is losing in him a most faithful servant, (applause) but he will remain a faithful friend, and you may be sure that if at any time matters affecting Canada are discussed in the National Parliament, he will be ready to take an intelligent part, contributing that practical knowledge and good sense which is generally apparent and is of real value. (Applause.) And it is surely well that it should be increasingly recognized that Members of Parliament have distinctly an added qualification for their duties if they have made themselves at least to some extent personally acquainted with the different features of the Empire. It is a good many years now since Lord Rosebery, having himself set an example in that respect, advocated the importance of this branch of political education, and since that exhortation was uttered I may say that I have been one of those who have noted its worth by having travelled in India and Australia, and also long before I had any idea that I should be sent here officially, in Canada—and in the greater part of our tour round the world I was accompanied, as it happens, by the Member of Parliament of whom I have been speaking, Captain Sinclair.

Certainly I shall always take an opportunity of urging my younger friends in public life to take all opportunities of visiting the main portions of the Empire, commencing, of course, with Canada.

I must thank you again, Mr. Chairman and gentlemen, for your kindness and cordiality on this occasion, and also for the kind manner in which you have listened to my remarks. (Loud applause.)

Mr. G. H. McLeod sang "Scots Wha Hae" in his usual brilliant style.

"THE PRESIDENT OF THE UNITED STATES."

THE CHAIRMAN.—Your Excellency and gentlemen, it is with much pleasure that I ask you to give a most cordial response to the toast which I now have to propose—the health of the President of the United States. (Applause.) I ask you to do this to the President not only as the chief ruler of the great neighboring Republic and kindred nation, but also to the President as a man who has done his best to promote peace and good will among his own kith and kin. (Applause.)

The toast was cordially received, the orchestra playing "Yankee Doodle."

DR. ANDERSON, UNITED STATES CONSUL GENERAL, in replying said: Mr. Chairman and gentlemen, this friendly recognition of a neighboring Republic, who, although living under another flag, another form of government, are yet so frequently received and accepted by you as kinsmen, cannot but excite a lively emotion of gratitude and satisfaction in the hearts of all citizens of that country temporarily residing in your midst. (Applause.) As such to-night, in behalf of the people of that country and for their chief executive, permit me to express to you my sincere appreciation and thanks for the manner in which you have received this toast. I accept your greeting and good will expressed with great pleasure. This pleasure is enhanced by the presence of the representative of Her Most Gracious Majesty and the fact that he has joined with you in extending this greeting. (Applause.) It will be my pleasure, so far as lies in my power, to convey this greeting to those for whom it was intended as another and additional evidence of your desire to strengthen the friendship and brotherhood between the two great English speaking nations of the world. (Applause.) Such an expression at this time may possess particular value and importance, for there never was a time in our history when rational action, when widespread and collective influence might be so potent in promoting, if not securing, the fulfilment of the desire and prayer of civilized people all over the world for ages, that peace on earth which is now foreshadowed by the negotiations pending between our two Government. (Great applause.) It is true we have some fire-eaters in the United States ; I believe you have some in Canada also. (Laughter and applause.) They certainly made their existence manifest on both sides of the line within the past year. It is not my province to discuss the causes which afforded the opportunity, but we remember with regret how the sparks of discord were fanned almost to a white heat, how black and ominous were the clouds over our head until the great conservative sentiment of both countries assrrted itself and was heeded. (Loud applause.) This disturbing element may be, and I believe is great over-estimated, and I believe it may be greatly over-estimated for the same reason given by the farmer who happened to have a good sized pond on his farm, and hearing that a certain class of peoole in a hotel nearby were fond of frogs' legs, he went to the proprietor and offered to make a contract to deliver at a day's notice two car-loads of frogs. When the proprietor overcame his astonishment and declared that he could not possibly use so many, he finally compromised by agreeing to take on the following day six dozen frogs. The time came and the old farmer made his appearance with a basket in which there were eleven frogs, and made the statement that that was all he could find. "Why," said the landlord, "I thought you were prepared to deliver two car-loads." "Well," replied the old farmer, "I thought there were two car-loads by the noise they made before I came here." (Laughter and loud applause.) But even though their number may be small, His Excellency has already told you what the small boy with fire-crackers can accomplish, and it is well for us to remember that a healthy, well-formed mosquito can disturb, in the stilly hour of night, the tranquility of the best disposed individual, and we should remember also that the cow of Mrs. O'Leary gave a kick that resulted in the destruction of the City Chicago. (Hear, hear, and applause.) Hence I believe that we should join hands in putting up such safeguards as will prevent our over-zealous kickers and mosquitos from destroying our national prosperity. (Applause.) Recently standing in the doorway of the banquet hall of this same hotel I heard the distinguished President of Harvard College declare that it seemed unthinkable that these two great nations, which enjoyed as great a state of personal justice and perfect liberty as any two nations ever did see, should relapse into the savagery of war for the settlement of differences between them. It does indeed seem hard to believe that we should relapse into such savagery. But while he spoke of his country and mine, there arose before me that four years of fratricidal strife and savagery, and the destruction of many structures, and my mind was carried, as no doubt was also that of the honored head of Harvard College, to the memorial building of that college, where in the central hall you will find the walls covered with inscriptions and tablets to the memory of those sons of Harvard who lost their lives in that same war, that relapse into savagery in our own country. I believe that while war was but an incident in its history, it admonishes us to spare no effort, to do all that we can to promote the ratification of that treaty that is now pending between Great Britain and the United States. (Applause.) Mr. President and Gentlemen, this is a meeting of mining engineers, I believe, and if the evening was long enough I should like to tell you what I don't know about mining, but the evening is too short for that. But there is one thing; whilst I am here in the midst of scientific men, I should like to have explained—I am referring to the United States and our sections where the precious metals are found: and I would like some scientist to tell me what there is in the atmosphere of such a country that tends so largely to exaggeration. (Applause.) A few years ago, out in the State of Colorado, I had occasion to pass a few weeks in a mining camp up in the classic shades of Buttermilk Gulch. Before taking the trail to that mountain resort I supplied myself with checked shirt, overall, top boots and the other paraphernalia that was necessary, but when I reached the ranch an old miner there read through my disguise as easily as President McKinley does the lofty and disinterested patriotism of those who are daily visiting his home at Canton. I was put down as a tenderfoot. Shades of Munchausen! what a feast of fiction was offered to me during my few weeks stay there. Before I visited that country I used to think that it was a pretty strong story told by the man who wished to impress his friends with the almost inconceivable heights of the Himalaya mountains. He told them that one day when he was far up on the side of the mountain with his gun he shot at something in the air and when it fell at his feet he was horrified to find that it was a cherubim. (Great laughter.)

I thought that a pretty strong story, but that man could not pass an examination to enter the primary department of that mining camp. (Laughter.) Why, I was expected to believe and report that a shaft 88 feet in depth was 136 feet by actual measurement and a cloud of witnesses; I was expected to believe and report that a vein of ore which I could span with my hand was 18 to 26 inches in thickness; I was expected to believe and report that a few stunted pines a mile or two down the gulch was a forest right at the mouth of the mine which would furnish stulls for a century; I was expected to believe and report that the roadway up the mountain at an angle of about 45 degrees was practically a dead level, and so on through the whole category of mining camp surroundings. And to cap all, as I was about to leave the old miner expressed his regret that he had not had time to show me one-fourth of the merits of that mining region. (Laughter.) I thought I would leave something for his comfort, and I assured him that if I did not leave that country an accomplished liar it was not his fault. (Laughter.) I have no doubt, gentlemen, that you think I profited by my experience. (Laughter.) I should say, however, that that was before I had ever taken any part in politics. (Laughter.) I fear I am taking up too much of your time. (Cries of "Go on! go on!") I thank you again most sincerely, and I assure you it is no formal thanks. I thank you again for the cordial manner with which you have received the toast of the President of the United States. (Applause.)

Doctor Louis Frechette recited in a brilliant manner "The Battle of Waterloo" in French.

"THE DOMINION HOUSES OF PARLIAMENT."

Mr. Geo. E. Drummond proposed the toast of the Dominion Houses of Parliament, coupling with it the name of the Hon. W. S. Fielding, Minister of Finance.

HON. W. S. FIELDING, Minister of Finance, in responding said:—Your Excellency, Mr. President and gentlemen, I desire to express my very warmest thanks for the handsome manner in which the toast has been proposed by our friend Mr. Drummond, and the hearty manner in which it has been received by the whole company. To me it is especially an agreeable duty to come to Montreal to-night and to participate in an assembly of gentlemen to whose intelligence, energy and capital we shall be so largely indebted for the future prosperity of the Dominion of Canada (applause). I have personal reasons for regarding the occasion as a pleasant one, because I have the opportunity of renewing very many pleasant acquaintances of former years, and also because the occasion recalls to me many very agreeable events of past years when in my own province I had the opportunity of enjoying the good company and the generous hospitality of the mining fraternity. (Applause.) Indeed, looking around me to-night, I might also imagine myself down in Nova Scotia again. I well remember one occasion which was of broader character, when the representatives of the mining industry in the province of Quebec went down east and joined their brethren of the Lower Provinces in that memorable meeting where they discussed mineral matters in the midst of the splendid mineral wealth of Cape Breton. I believe that meeting was of more than ordinary importance, because I understand it was the foundation of the occasion under which we are assembled here to-day. I believe that in the parlor of the Sydney hotel one night, which I remember well (applause)—I hope my Nova Scotia friends will not think I am going to give away any secrets—but I believe that in that parlor on that occasion there was prepared the beginning of the organization which has now taken the shape of the Canadian Mining Institute, and therefore, I recall that occasion with very great pleasure, not only for its social merits, but because of its connection with your present organization. (Applause.) Nor am I likely to forget the memorable meeting in the city of Montreal when the American Institute of Mining Engineers had a very grand gathering in this great city, and I am sure that on that occasion much was done to advance the mining interests of Canada. (Cheers.) And so, Sir, I have many reasons for regarding the present occasion as one personally agreeable to myself. If I were an older member of the House of Commons I might hesitate to speak much of it because I should be open to the suspicion of praising myself, but as I have but recently joined the ranks, as I am one of the cadets in the House of Commons, I am free to speak of it with greater warmth, and I venture to say, that all who have ever heard the debates at Ottawa will, irrespective of politics, be proud of the House of Commons of Canada. (Cheers.) I remember when Charles Dickens came to America on his first visit—he came by a Cunard steamer to Boston—he spent a few hours at Halifax, and was present at the proceedings of the provincial Parliament, and in one of the chapters of "American Notes" he said of this event: "It seemed to me that I was looking at the proceedings of the British Parliament through the wrong end of the spy glass." That expression would not suit the Parliament of Canada however. I thought that what was in the mind of Dickens was happily that in the colonies he found that our Parliametary institutions followed the principles, examples and traditions of the great Parliament of the mother land. (Loud applause.) We have to-night at our Board a distinguished Member of the Conservative party who presided over the deliberations of the last Parliament of Canada, and presided with great dignity and honor. (Applause.) And to-day, through the changing currents of politics, another gentleman fills that high position, and fills it with great ability and honor—(applause)—and it is a great comfort to know that however we may differ—and men must differ in the Parliament of Canada—there is among the men on both sides of the House a desire to uphold the honor and dignity and the privileges of free Parliamentary institutions. (Cheers.) It has been so in the past, and I am sure, sir, it will continue to be so in the future. But while I speak of Parliament generally, I remember that after all I represent only the Committee of Parliament—that Committee which is called the Government. Now, it is difficult to speak of that Committee without trenching on the debateable lines of politics, but I am quite sure you will agree with me when I say that it ought to be possible to make passing allusion to public affairs, to political affairs, without giving offence to those who differ from us. (Hear, hear.) If I have any fault to find with the public just now, it is that they expect a little too much from that Committee called the Government. The Scriptures tell us that "to whom much is given much shall be required." And much has been given to the Government of the day in the way of public confidence and respect. We have the support of a loyal and generous party, and it is but right to say that among those who have opposed the present Government there has been, and is to-day, a warm and generous disposition to give the Government a fair chance and fair play. (Applause.) We have had many evidences of that disposition from gentlemen who have differed from us in the past, and who perhaps will retain the right to differ from us in the future. But while we ought to recognize, and we do recognize, the fact that among all classes in the community there is a strong disposition to wait a reasonable time and see what will come out of this Government, still there are some who have such a good opinion of the capacity of the present Government that they are disposed to expect too much of it; they would like it to accomplish in a single session what might well occupy their attention very creditably during the whole parliamentary term. (Hear! hear!) But while I am not going to make rash promises I think we may have the consolation of knowing that we may have a second parliamentary session—I do not go so far as to say a second Parliament—but there is the session which is close at hand, and then another session, and if everything is not accomplished during the present session we can look forward to the session that is to follow (laughter). Now there were three great questions in the minds of the people at the time that this Government came into power. Whether right or wrong we won (applause) and the people have been looking to this Government to deal with these three questions. First, there was that vexed question of schools, nominally local in its character but actually wide reaching in its character; that question which seemed to divide our people in a most unpleasant way. I am sure that everyone in Canada will feel that he can rejoice if that question was considered settled. I do not suppose that any question could be so perfectly settled that there would not be somebody to say that it would have to be settled yet. I shall not dwell upon it further than to say this, that it is settled so far as any question of the kind can be settled in Canada. I make the statement with a full sense that it may be tested by time, when I say that that question is so far settled that no political party will take it up again. If that be the case, while I have the most profound respect for the men who do not agree with that settlement, I say whether rightly or wrongly, that question is settled so far as political parties can settle it, and it will not be taken up again by any political party in the present Parliament of Canada. (Applause.) And if that be true, and we have settled that question on these lines, I think we may claim to have done something towards what will be for the making of Canada. Then there is the great question of tariff reform, and that question has been occupying the attention of the Government in a very close way. I, at all events, must plead that I have had to give it very close attention, and this I will say that in view of the wide diversity of opinion that has been expressed at the various tariff meetings, we have no hope that we shall be able to please everybody, but we have a strong hope that we will be able to devise such a tariff measure as will vindicate the policy laid down in the great liberal convention which was held in Ottawa. Many of you gentlemen differ from that policy, but I think that policy is one to which we are committed, and if we are to win the respect of our friends—nay, if we are to win the respect of our opponents—we must be true to the policy which we have proclaimed to the people of Canada. That was a policy of reform and not a policy of revolution. (Applause.) To use the happy expression of Sir Oliver Mowat, we are conscious of the difficulties of the position ; we are conscious of the wide divergencies of opinion ; but I want to assure this meeting that we are approaching this question with an earnest desire to carry out the principle to which we are pledged, and I believe we can do so in such a way as to do no injustice to any legitimate interest in the Dominion of Canada. (Applause.) Then there was a third great question to which we had to give attention, and one which is a vital question to-day, because as we speak here to-night the train is carrying two of my colleagues to Washington, to discuss with the American Ministers at the American capital better relations with our country to the South of us. We are conscious of the fact that it has been stated that we were too anxious to have friendly relations with these people. If that be an offence we plead guilty to it. We are anxious to have friendly relations with the United States. (Hear ! hear !) I know that there are extremists on both sides of the Line, as my friend the Consul General has said, who have tried to make trouble. I know we have a few people in Canada whose mistaken zeal has led them to believe that in order to be thoroughly British they have to be suspicious of their friends across the border. We believe that it is a mistake. I believe that every statesman will agree with me when I say that the people of Canada can do no better service to the mother land than by cultivating friendly relations with the people of the neighboring Republic. (Applause.) We are willing to admit that such has been our earnest desire, to cultivate such relations, and the responsibility has been cast upon us to approach our American neighbors and tell them candidly that such is our desire. We are going to make an earnest effort to bring about better relations between these two great peoples, because we believe that it will be better for the five millions of Canada, and better for more than five millions across the Line. But let there be no mistake. It has been the misfortune of the Canadian people at times to be misunderstood by our friends across the line. Living under Republican institutions, they have been led to believe that only under American institutions can liberty flourish. We have shown them that that is a mistake; that in Canada, owing allegiance to Her Most Gracious Majesty, we could have a degree of liberty which is no less than theirs, and we are proud to declare that fact to them. (Applause.) And while we go to them with an earnest desire to bring about these better relations of which our friend the American Consul has spoken to-night, at the same time we are prepared to declare that we propose to be citizens of Canada and citizens of the grand old British Empire. (Loud and prolonged applause.) We propose to say to the American people, and we believe we can say it in the name of the people of Canada, in the name of the best people of Canada, both Liberal and Conservative, that our earnest desire is to establish friendly relations with these people; but if after we have made that offer to them they do not see it to their interest to agree with us—if they think there is no business in it for them, if they think there is no money in it for them, then we can say that we have done it in good faith. If they reject our offer, then we propose to gather ourselves together and say that as citizens of this great Empire we are going to work out our own salvation. (Applause.) And if there be within the great Republic people who are so ill-advised as to imagine that by any commercial policy they can adopt they can in the smallest degree interfere with our devotion and loyalty to the mother land, we say that they will discover by experience, if they have not already discovered it in the past, that Canada proposes first, last and all the time to be thoroughly Canadian and thoroughly British. (Loud cheers.)

HON. PETER WHITE:—May it please Your Excellency, Mr. President and gentlemen, when I made up my mind to attend this banquet here to-night I little thought that I would be called upon to respond to the toast of the House of Commons, from which the will of the people has excluded me at the present time. I feel, Sir, that that institution is one of the great institutions of the English speaking people. I have had the pleasure of sitting in Parliament for a great many years. Mr. Fielding has been kind enough to pay me the compliment of saying that I presided over the deliberations of that body during the last Parliament with dignity and with credit to the Parliament of Canada (applause). I am afraid that in the kindness of his heart he inclines to be too complimentary in regard to the course which I pursued during that period of time. At all events, whatever may have been my shortcomings and faults, I endeavored to discharge my duty to the best of my ability, and in the discharge of the duty which I was called upon to perform during the last Parliament I can say with truth that all the members of Parliament on both sides of the House gave me the greatest assistance and the greatest possible consideration. We, Sir, in the Parliament of Canada differ in our political views. Some of us hold views in one direction and some in another; those views are diametrically opposed to each other; but whatever may be the political complexion of Parliament, whatever may be the political complexion of the party in power, my experience has been that every Member of Parliament has endeavored to the best of his ability to promote the best interests of the country. Whether Grit or Tory, Liberal or Conservative, the great desire of the members of Parliament was to promote the interests of this—shall I call it a nation?—Sir, I hope it will be (loud applause); and whilst I do not agree with the gentlemen who now control the destinies of Canada, I admit with all frankness that I feel satisfied, and I am re-assured by the statement of Mr. Fielding to-night, that those gentlemen are as truly Canadian as we pride ourselves on being (applause). Sir, I trust that when these gentlemen come to negotiate with a foreign country a treaty which will have for its object freer trade relations between these two countries—and I am glad to be assured by a responsible member of the Government here to-night—the interest of Canada will be first, last and always in their minds (applause), and that whatever may be the result of these negotiations that the interest of the people of Canada will not be forgotten by the Government, which have been charged by the majority of the people of this country with the management of their affairs for the next five years. While naturally I am not going to say that I wish for them another parliamentary term, they will no doubt have another session of Parliament, perhaps two, three or four sessions, but of course as disagreeing with them politically I naturally hope that they will not have the opportunity of another parliamentary term. At all events, however, speaking with all candour I may say that I am prepared, because I cannot help myself (laughter), to give these gentlemen the fullest opportunity during this Parliament to show the people of Canada what they can do to promote her interests. I will give them the credit of doing the best in their power according to their light to promote the interests of the country (cheers) I have been taken advantage of to-night and did not have an opportunity to prepare any set speech, but I may say that I am pleased to have an opportunity of expressing to this magnificent assemblage my thanks for the kind, hearty and complimentary manner in which this toast has been proposed, and the hearty manner in which it has been received. (Applause.)

MR. G. H. MCLEOD sang, in fine style, "The Minstrel Boy," followed by the Zingari Banjo and Mandolin Club, which gave some fine instrumental selections, the Hancock March being much appreciated.

"THE LOCAL LEGISLATURES."

HON. C. C. COLBY, gracefully proposed the toast of the Local Legislature.

HON. THOMAS CHAPAIS, who responded, said:—"Your Excellency, Mr. Chairman and gentlemen, it is indeed a pleasant duty to be present here at this gathering as a representative of the Local Legislature. I would be most happy to give you a good English oration, but I am sure that you have already noticed my very poor English; nevertheless, I will try and address a few words to you in the language which is the mother tongue of the Mining Institute and of this gathering. (Applause.) Gentlemen, I am here to-night to tell you that the Provincial Government and Legislature are in full sympathy with the objects of your Institute, with the great aims you have in view, and with your strenuous and praiseworthy efforts for the development of the mining resources of the Province of Quebec especially, and of the Dominion at large. (Applause.) As a proof of that sympathy the Provincial Government has thought proper to give a larger place to the mining interests in the organization of our public department. We have now the new department of Colonization and Mines, and I may tell you that we intend to do our utmost in favor of the great cause to which you have devoted your energies, and to develop the mining resources of our Province. (Applause.) Sir, this is a very happy occasion for me to make my first public statement as the new Commissioner of Mines for the Province of Quebec, and I will avail myself of the opportunity. Mr. Chairman and Gentlemen, I have the great pleasure in making known to you that the Government of the Province has finally decided by an Order-in-Council, signed to-day by His Honour the Lieutenant-Governor, to give the Mining Association of the Province of Quebec a grant of $2,500 for the establishment (applause) of a mining bureau in the centre of this great city (renewed applause). That is to say we propose to give the sum of $1,500 for the annual rent during five years, and $1,000 more during the first year for equipment and installation. (Applause.) Mr. Chairman and Gentlemen, I do not want to detain you any longer in my broken English. I thank you for your kind reception; I thank you for the noble manner in which this toast was proposed and received, and I wish every success for the Federated Mining Institute and the General Mining Association of the Province of Quebec in their endeavors and labours. (Great applause.)

Mr. G. W. Stephens, Jr., sang in splendid voice, "The Brigadier," in French, and Dr. Drummond recited his original poem, "Le Chasse Gallerie," and gave another original poem in response to a hearty encore.

OUR MINERAL INDUSTRIES.

Hon. W. S. Fielding,—Your Excellency, Mr. President and Gentlemen, I shall detain you a moment in proposing the toast which has been allotted to me, though one might be justified, having regard to the occasion and to the gentlemen who surround this Board, in calling it the toast of the evening, "The Mineral Industries of the Dominion." I am sure we have all learned with satisfaction of the story that is thrust upon us from day to day of the magnificent discoveries of mineral wealth in British Columbia. To-night we have heard from the Hon. Mr. Colby some account of the splendid mineral wealth of Quebec, but I know that in the great Province of Ontario also there is a development of mineral wealth which bids fair to rival even British Columbia itself, and in the Province of Quebec we know that for a long time we have had mining interests of the greatest importance, and to-day we go further into the Eastern Provinces we know there we have had for a very extensive operation in minerals, not only of coal—of which we produce two millions and more every year—but also gold and iron industries, which are attracting widespread attention. I may say that the public returns of the Province of Nova Scotia show that in gold mining they have had one of the most successful years in the history of the country. (Applause.) I am sure that we can all agree with the remarks made by Mr. Drummond, that we have reached the mining age of the Dominion. Whatever may be said of other industries, we know that the mineral industries of Canada are of her greatest natural resources, and anyone connected with the public affairs of the Dominion should be ready and willing to render such assistance as will give them a fair chance to be developed. (Applause.) Without further remark, I give you most cordially the toast, "The Mineral Industries of the Dominion." (Enthusiastic applause.)

Mr. B. T. A. Bell sang most acceptably, "Drill, ye Terriers, Drill," with a characteristic musical accompaniment, the fine chorus being taken up lustily by the company.

MR. F. A. HEINZE (British Columbia Smelting and Refining Company) of Trail, B.C., was the first to respond to this toast. He said: "Your Excellency, Mr. Chairman and Gentlemen, I feel that the hour is growing late, and while I was notified by your energetic Secretary that I would be called to speak to-night, and am therefore unable to plead the excuse of Mr. White and Mr. Colby, still I have considerable trepidation in addressing you this evening. I wish to state before I start that while I have some profession to being a mining man, to being a smelting man, and to being a railroad man, I have none whatever to being an after-dinner speaker. (Hear! hear!) Now I have been called upon to make some remarks about British Columbia. You have all doubtless heard of this virgin Province of the Dominion. I may state that I am one of the pioneers in the mineral development of British Columbia, and I am a firm believer in its future. I have spent large sums of money in the development of the natural resources of the Province, and in furthering the investigation of its possibilities. I believe, gentlemen, that there is no Province in the Dominion which offers greater facilities for investment to an enterprising man than British Columbia does to-day. (Applause.) I believe, however, that the mining industry of British Columbia has also at present a surfeit of what we of the mining profession call curb-stone brokers, men who mine on the curbstone and not in the ground. (Laughter.) I trust, gentlemen, that you, as members of the Federated Canadian Mining Institute, will understand what I mean. (Hear! hear!) I have mined all over the United States, I have mined in Mexico and I have mined in Canada: I have done what I could to develop the mineral industry, the mineral resources of the different parts of this province which have been brought to my notice, and, gentlemen, I am forced to say that no region has ever come to my notice which to my mind offers the possibilities that British Columbia does to-day. (Applause.) We have, gentlemen, in that province, an aggregation of wealth in the ground, which, should I attempt to give you an adequate description, might lay me open to the charge of being too enthusiastic, of going beyond the realities of the situation. And yet, when you gaze upon the map of British Columbia from the time you start from the eastern side of the province to the west, there are indications which rival any part of the world in mineral possibilities. (Applause.) As I said before, in a small way, I am connected with the railroad interest, with the smelting industry and with the mining industry. Mr. Heinze then referred to the great possibilities to the country to be derived by the development of the Crow's Nest coal field, the great resources of the Fort Steele district in silver, the Slocan, Trail and other camps which are now beginning to attract attention. In conclusion he asked them to join him in drinking success to the great mineral industries of British Columbia. (Applause.)

Mr. W. H. Nichols (Nichols Chemical Co., Capelton, Que.,) of New York, was also asked to respond. He said: Gentlemen, when the almost world-renowned Secretary of this organization did me the honor to inform me that I was expected to address this gathering, I wondered why I should be expected to say anything at a meeting like this, composed of mining men who knew the province better than I did. Still, as I thought it was due to my regard for the mining industries of the Province of Quebec, my enthusiasm rose; but as I wended my way northward, and as I reached your fair City of Montreal, I found that that enthusiasm had almost entirely disappeared. The reason for this was not far to seek, as I felt my own inadequacy to do the subject justice, while to add to my discomfiture I have been placed between British Columbia cranks and a lot of Nova Scotia sharks. (Oh! and laughter.) What is a poor representative of Quebec to do in such company? I can say this, however, that Quebec may not have the mountains of British Columbia, or possibly its natural gas (laughter and applause); she may not have the gold nuggets of Nova Scotia, although I have seen some very handsome ones which have been reported to me, a tenderfoot, as having come from the Province of Quebec; and yet, after all, the old Province of Quebec has no cause to hide her head in this or any other assemblage. (Applause.) While she does not claim great riches in minerals, yet after all she has done something for Canada and for the world in the development of her mineral resources. (Applause.) Quebec has furnished large quantities of what Canada has very much more of than what Canada needs; I mean the phosphates (applause), where we find the possibilities of vast industry. This industry is now suffering from a "Florida Enchantment," but it will be heard from again. Quebec also possesses vast quantities of copper pyrites, which not only contains the metal which gives it its name, but also the element which added to phosphates gives the fertilizer which Canada needs. It always seems to me that the farmer who needs it so much does not know the value of phosphates as a medium for replenishing his worn out lands. In the United States the annual consumption of fertilizers is 1,500,000 tons, or more, while in Canada the consumption is a very few thousand tons. The industry will have to remain a little dormant until the farmer realizes the value of these fertilizers. The province also supplies the asbestos product of the world, while its mica and chromic iron production is rapidly gaining prominence. Now, Mr. Chairman and Gentlemen, this is the first time I have ever had the pleasure of seeing a real Governor-General. (Hear, hear, and applause.) I came very near seeing one a while ago, in the fact that my good wife, who visited the House of Parliament at Ottawa with me, in passing through the Senate Chamber was told that a certain place was the throne. She immediately seated herself upon it to see how it felt, so that I feel that I have a kind of passing acquaintance with His Excellency. (Laughter.) I was assured that he was a jolly good fellow. (Hear, hear.) I must say that from my intercourse with my brethren in Canada for a great many years, he is simply a type of all the men with whom I come in contact. I have never met, and I can say it without flattery, and I have a wide experience, I have never met a more earnest and more reliable lot of men than I have met in this part of the hemisphere. (Applause.) I notice that you recognize the allusion. I have been very much interested to-night in hearing what the Honourable Minister of Finance had to say. What little I had seen of public men in Canada it so happens that I have been brought in contact with the gentlemen who have formed the other party. Of course I have no politics in this country. On the other side of the line nobody knows what his politics are, as they change so often. In that country I am known as a mugwump. I know in Canada there is only one mugwump, the Hon. Peter Mitchell (laughter), but in our country there are a great many mugwumps. (Hear, hear.) But I was never one of those who believe that all the virtue existed in one party, and while I confess to having watched the last election here, and I noticed the result with a great deal of surprise—for I had been told that there would be only one result and that was the other—still my surprise did not result in any feeling of chagrin, because I recognize that there is no great party elected to power by any great people, with all the responsibility that that position entails, which will not do its very best, not so much to sustain its party as to do that which it believes it is best for the country. (Applause.) And after what the Hon. Minister of Finance had to say to-night, I found that the country was as safe as it always had been, and as far as my interests are concerned I leave them in his hands and in the hands of his coadjutors, knowing that if they make a mistake of the head I feel confident that they will not make a mistake of the heart, and knowing that the people will be relied upon to correct that mistake. Now, gentlemen, I did not intend to take up so much of your time. I will take my seat in a moment. I have said very little for Quebec. Quebec speaks rather by actions than by words. I believe in its future. It has already shown its interest in the mining development by a grant to the Institute from its Provincial Legislature, as we have heard to-night. I sincerely trust that the Dominion will find it to their interest to also make a grant, and that they will continue it indefinitely, as I believe it can be shown to be in the interests of the whole Dominion. (Applause.) As a taxpayer I would be willing to have my burdens increased in that direction. I thank you for the courtesy extended to me, a stranger, but I can assure you that I will be glad of the time when I decide to cast my lot in this direction. (Applause.)

MR. WILKES here sang "Drinking," very acceptably.

OUR MINING SCHOOLS.

MR. B. T. A. BELL,—May it please Your Excellency, Mr. Chairman and Gentlemen, at this late hour I do not propose to say a single word in respect to the next toast on the list. In this company it is wholly unnecessary to eulogise the work of our technical schools. I ask you to drink a rousing toast to "Our Mining Schools."

DR. GOODWIN, of the School of Mining, Kingston, in responding said: Your Excellency, Mr. Chairman and Gentlemen, at this late hour it would ill become me to say more than a very few words in response to this toast which you have drunk with so much enthusiasm. It has been hinted several times this evening that miners are not very truthful, and as this accusation has been received in silence, we may take it for granted that it is, to some extent, true. (Oh!) There are two other classes of men who are not considered very truthful, namely, lawyers and those whom we may consider horsey men. I have heard it whispered that lawyers have redeemed themselves from this imputation, and the third class might be said by some people to be beyond redemption. But I think we may consider that the miners are open to salvation, and it will be one task of the mining schools of Canada to do what they can to convert them to honest ways (applause). We have heard this evening a great deal about the mining possibilities of Canada. It will be one of the tasks of the mining schools of the Dominion to turn out men to convert these possibilities into probabilities, and ultimately, we hope, into paying realities. The school which I have the honor to represent in particular is not yet four years old, but it is, I am happy to say, a vigorous and growing school, full of promise, and I hope, perhaps, in some respects, owing to situation, that it is likely to grow as rapidly as the demand for the kind of men which the country needs. I thank you again for the kindly manner in which you have received this toast. (Applause.)

OUR GUESTS.

MR. A. W. STEVENSON,—Your Excellency, Mr. Chairman and Gentlemen, the toast I am about to propose is one of the most important on the list. We have with us this evening a great many very distinguished guests, and I only regret for the sake of those present that we will not have the pleasure of hearing from them all. We have with us the Rev. Dr. Barclay (applause), a gentleman whom we see too rarely on occasions of this kind, and therefore we all the more appreciate his presence this evening. We have with us Principal Peterson of McGill University, a gentleman known to you all. We have also with us the President of the Montreal Board of Trade, Mr. McKergow, as well as Mr. J. H. Perreault, of Chambre du Commerce; also Dr. Dawson, of the Geological Survey, and our old and esteemed friend Dr.

Selwyn. We have representatives of the Banking and Railway interests of the Dominion, but with your kind permission I will ask Dr. Barclay, Mr. McKeagow and Principal Peterson to reply to the toast of "Our Guests."

REV. DR. BARCLAY, who was the first to respond, said :—Mr. Chairman, Your Excellency and Gentlemen, I very greatly appreciate the kindness which has made me one of your guests this evening. When I received the invitation I felt the honor, but I did not fully appreciate the extent of that honor until I read the address of your President in this morning's papers. I had always looked upon mining as one of the principal industries of the world, and upon miners as a very important factor in the human race. But I never knew until I read that address that mining was the industry of the world upon which the others were dependent, and the industry which more than all others promoted the culture and civilization, the material and social improvement and welfare of the human race. Your President said that mining was the basis of all the progress and civilization of our race, and that miners were the converters of countries and continents (hear, hear). He called mining the Queen of Science, and to this science he gave a handmaid which he called metallurgy, and mining and metallurgy requisitioned into their service nearly all the other sciences. I noticed, however, that there were two sciences to which he owed no indebtedness—astronomy and theology. I was not very much surprised ; indeed I thought it somewhat natural because these two sciences dealt mainly, theology with the things that are above and mining with the things that are below (laughter and applause). Well, notwithstanding the fact that he made no acknowledgment of indebtedness to the science of theology—I do not specially recognize any connection between mining and theology—I do not feel the least bit from home because I am surrounded by miners. From what I have sometimes heard and sometimes read, and from what I did hear from Dr. Anderson to-night, I came to the conclusion that theology, of course, in a somewhat diluted form, might be offered to advantage to some of your mining centres and mining camps (applause). After all, human nature everywhere is very much alike, and human industries and governments have a marvellous similarity. Our occupation after all is a kind of mining, a very difficult kind of mining, and sometimes a very disappointing kind of mining. Our duty in life is to try to discover and to develop the true metal of humanity (applause), and in our endeavors and researches we come upon some of the most unlikely and some of the most unpromising surface, and yet by patient endeavor and by genuine honest work we sometimes discover a little of the true metal ; and I am sure you will agree with me when I say that of all the discoveries and developments that we know there is none that yields better interests and adds more to the exchequer of humanity (applause). It is very hard sometimes to find even a trace of the true metal, and, when we do find it, it is so mixed with alloy that in vain would your best mechanical appliances assist in the separation. We too, like you, have constantly to change, vary and modify our appliances and instruments, but I think that you will admit that after all we have not been the less useful and less successful in developing the true gold of humanity. (Applause.) We have also a different kind of mining to do. We have got to dig deep into the ponderous tomes of ancient and modern lore, to mine all the wealth and also the folly of passing centuries. I myself have dug deep into some of these volumes, and found as a result that I had a ton of alloy and scarcely an ounce of gold, and thankful even for that. When we do meet with a little of the true metal we find that the people do not want it. They prefer the alloy, and they keep to it and they cling to it. (Hear, hear.) We have also another difficulty, that when after a great deal of laborious research we get a little of the precious metal there is no rush on the part of the public to secure it. We cannot boom it. (Hear, hear.) I am very glad that you recognize the clergy to-night. I sometimes feel that we are not sufficiently recognized at public occasions of this character. (Hear, hear.) I congratulate you on the importance and success of your meetings, and I congratulate you most of all upon your expressed determination that whatever desire you may have to see your interests advanced you are resolved to protect the ignorant and the innocent, the unsuspecting and credulous public from fraud. Analogy runs throughout the whole of life, and I always think that iron and gold are the natural allies for integrity and honesty, and that they may be united is my earnest hope, and I know that it will be your earnest endeavour to continue that union. (Loud applause.)

Mr. JOHN MCKERGOW, President of the Montreal Board of Trade, who was next called upon, said :—Your Excellency, Mr. Chairman and Gentlemen, I have a very few words to say to you at this late hour of the evening, but representing as I do the largest commercial body in this Dominion, I wish to heartily congratulate you on the success which seems to have attended your meetings. I have no doubt that to many people it was a revelation, as it has been to me, that the mining industry of this Dominion is of such importance, has attained such vast proportions. I think that in many ways of late, what we might call the boom in the mining industries of British Columbia, will indirectly do Canada a great deal of good. It brings the name of Canada before the world, and I have been very much pleased to-night to hear that this Mining Institute has set its face against any wild-cat schemes, against any unprofitable schemes which will result in loss to those who put their money in them. (Applause). Evidently from what has been said there are plenty of solid mines ; there are enough mines that will pay a good return on the investment, and I think something should be done to place these before the public so that the wheat and the chaff might be separated. (Applause.) There is another point in which the mining industry of this country is a very great benefit from a commercial point of view. The miners are producers. They produce the wealth from the soil. They are also large consumers, and in that way they are a great benefit to the agricultural and the manufacturing industries of this country. It is with great pleasure that I express the hope that in the future the mines of British Columbia will be opened up so that a large immigration will flow into that Province and find profitable employment. The adjoining territories and also Manitoba will find a home market for their produce which it needs. They have been beginning of late years to offer wheat and grains, and with a large market in British Columbia they can follow their farming successfully and in that way prosper. I am much pleased with what I have heard to-night and I thank you for the opportunity you have given me to say a few words; on behalf of the body which I represent I heartily congratulate you, and I hope that when you have a meeting again, as I presume you will yearly, you will be able to report great progress. I thank you, gentlemen, for the kind attention you have given me. (Applause).

Mr. L. L. BROPHY, of the Mines Section, Geological Survey of Canada, then gave a topical song which he had specially composed for the occasion, and which was enthusiastically applauded. Some of his verses were as follows:—

If you want me to sing you a topical song,
  I can sing till the sweet bye and bye;
It may be all right and it may be all wrong,
  You'll know best in the sweet bye and bye.
But on one point I trust that you all will agree,
If there's anything wrong you won't blame it on me,
And I'll mention some things, that perhaps you may see
  Come to pass in the sweet bye and bye.

Now I know that of course you're not out for the dust:
  It's no use in the sweet bye and bye;
Your motto, I'm told, is "Be healthy and just,
  And lay up for the sweet bye and bye."
If, however, by some, vulgar wealth is preferred,
Just float a few "wildcats," no risk is incurred,
At least, not just now—your reward is deferred,
  It will come in the sweet bye and bye.

We have men here to-night from way down by the sea,
  Come again in the sweet bye and bye;
We've had tales of Quebec and tall yarns of B.C.,

There'll be more in the sweet bye and bye.
Though in mineral riches these regions abound,
They're really "*not in it*" with what we have found;
We have *traced* miles of coal, just a foot underground—
'Twill be there in the sweet bye and bye.

I see here and there some retiring M.E.'s;
May they live till the sweet bye and bye.
Don't you think sweller titles might some of them please?
You'll find out in the sweet bye and bye.
Now that Canada's mining has reached such a stage,
And Jubilee honors will soon be the rage,
I hope they'll have letters enough for a page,
And a few for the sweet bye and bye.

The papers are full of a district called Trail,
And its chance in the sweet bye and bye;
If the prayers of the "widows and orphans" don't fail,
It may last till the sweet bye and bye.
Now to Rossland's shrewd boomers great schemes owe their birth,
Which to some may bring sorrow, to others much mirth:
If its cheap stocks advance, *servant girls own the earth*,
And won't work in the sweet bye and bye.

Dr. PETERSON, Principal of McGill University, also responded. He said: Your Excellency, Mr. Chairman, Honorable gentlemen and gentlemen, the knife of the executioner in the shape of the Chairman's inevitable mandate has fallen upon me. I am the last guest to intervene between you and the banquet hall deserted, and I rather fancy probably one of the last speakers who will endeavor to satiate that somewhat unconscionable bid for oratory which since my citizenship here I have noticed is one of the great characteristics of this Dominion. Gentlemen, I came here in what was I hope the laudable and the creditable aim of developing my education,—an education which I am free to confess to you must be said from many points of view to have only commenced when I came to Canada. I do not know very much about mining; it may be that I have been at times solicited to take some personal interest in the subject—something of that speculative interest which, whether with good or evil results, tends to lend additional interest to one's study of the daily newspaper. Hitherto I have not succumbed to this solicitation, and I am rather inclined to remember to-night that I also stand before you as the head of one of your great mining schools. I have had much pleasant intercourse with my neighbor the American Consul, and I am disposed to call your attention to the fact that during your proceedings for the last day or so you have had the co-operation of McGill University. (Applause.)

You have also had the co-operation of one for whom I have the profoundest respect, my friend Dr. Porter, and also Mr. Hardman (applause), to whom we were greatly indebted last winter at McGill. I refer to this fact to show you the cosmopolitan aims that McGill cherishes in securing for every department the very best talent available, no matter what country that talent may represent. (Hear, hear.) I heard Dr. Barclay say that human nature is the same all over the world, and it would seem so according to what was said by Mr. Nichols when he told you how his wife sat down on the throne in the Senate Chamber at Ottawa. It reminded me of an incident which occurred a few months ago, when I had the great privilege of attending the 150th anniversary of Princeton University. I stood there on an elevated dais with President Cleveland, and with that charming lady, his wife, and as soon as the place was cleared, and we retired, lingering behind for a time to study the characteristics of the crowd, I noticed how every woman who could possibly achieve the feat rushed to the dais and sat down on the chair that had been occupied by that gracious lady. (Laughter.) "Is this where she sat?" was the question which rose to their lips. (Laughter.) Gentlemen. I think that we had there again testimony to the fact that human nature is the same all over the world, no matter under what institutions we live. I am very glad to have been present to-night not only for my personal interests, but also that McGill may do something to develop these cosmopolitan interests, and to develop further that feeling of the brotherhood of nations which is so important for this Canada of ours. (Applause.) I shall say a single word in thanking you for remembering me, a new comer, a new settler, one ignorant of many of the things you have at heart, but one who yields to no one else in this country in his desire to further everything that is for the best interests of this Dominion, and who on the plane that has been allotted to him, to fasten every indication of popular sentiment and popular interest,—to attach you and those whom you represent to that institution to which my life will henceforth be identified. (Applause.)

"THE CHAIRMAN AND SECRETARY."

Lord Aberdeen:—I am afraid, Gentlemen, that when you see me rise you will be afflicted with a certain sense of nervousness, because, as you have been reminded, I am a British Columbia farmer, and as Mr. Nichols observed there is natural gas in British Columbia, and at this late hour of the night you do not want a supply of that article. But I can promise Mr. Nichols and you, gentlemen, that if we establish a natural gas company in British Columbia, it shall be a limited company. (Laughter.) My excuse for rising is that there is another toast that we should honor before separating, and that is the toast to the Chairman, and before we drink that toast let me say a few words. I think we may certainly congratulate the Chairman for the manner in which this evening has passed off. It is a notable occasion. In addition to the great interest which has brought this meeting together, there is another interest which is represented here, and which has not been referred to—the plough. It does not make so much noise as the drill, but the plough is a very important matter for the farmer and also for the miners. You, gentlemen, must be fed, and we farmers desire to turn an honest penny to supply your wants. I am glad that the Dominion is also represented by the Minister of Agriculture, Mr. Fisher (applanse), who has kept himself in modest silence. He is here, not only personally, but in his official capacity to show his desire to recognize this important interest. I congratulate the Chairman in presiding over such a gathering, and also in the manner in which it has gone off. Dr. Barclay has humorously referred to his address, but I had the pleasure of sitting under his ægis this afternoon. I am sure you will all heartily join in drinking this toast. (Applause.)

THE CHAIRMAN (Major Leckie):—Your Excellency and Gentlemen, I feel more deeply indeed than I can express to His Excellency the very kind manner in which he has proposed my health, and to you, gentlemen, for the cordial and enthusiastic manner in which it has been received. During the last year or more we have heard a good deal of Ian MacLaren and his charming sketches of Highland life and character, and I dare say that your Excellency has not missed some of the philosophy of the baker of Drumtochty. You remember his opinion was that "There is a good deal of risk in attending a marriage, because you never ken how it is going to end, but there is no risk whatever in attending a beerial." (Laughter.) Gentlemen, this is a kind of a marriage and a very joyful one it has been. It is a marriage of our federated interests, and I trust that you shall never have any reason to regret the most excellent idea which inspired our Secretary-Treasurer in bringing our Societies together in this Federated Institute. Gentlemen, he has been our inspiring genius, our guiding counsel and friend, and while I thank you most cordially from the bottom of my heart for the kindness that you have displayed, yet we must attribute the success of our meeting and of this banquet to my friend Mr. Bell. We cannot, I assure you, overdo the cordiality with which we respond to the toast when I ask you to drink his health and also to thank him for his untiring energy in bringing about this most successful meeting. (Great applause.)

Mr. B. T. A. Bell.—May it please your Excellency:—Whatever work there may have been incidental to the inception of our Provincial organizations and their expansion into our Federated Institute, has been amply compensated by this magnificent testimonial of your appreciation and good will. Mr, Chairman, I thank you heartily for your kindly references to myself, and you, my good friends all, for the very great compliment you have paid me and the very cordial manner you have responded to the toast, (Applause.)

One of the most successful banquets ever held in the Windsor Hotel was brought to a close in the wee sma' hours ayont the twal', by the whole company joining with great heartiness in the singing of the National Anthem.

Seventh Annual General Meeting.

MONTREAL, 2nd FEBRUARY, 1897.

The Seventh Annual General Meeting of the members of the General Mining Association of the Province of Quebec, was held in the Club Room, Windsor Hotel, Montreal, on Tuesday, 2nd February. There was a large attendance. The opening session was called to order at three o'clock. Mr. George E. Drummond (Canada Iron Furnace Co.) in the absence of the President, Captain Adams, being called to the chair.

The Secretary read the minutes of the Sixth Annual Meeting, held in Montreal on 8th, 9th and 10th January, 1896, which, on motion, were adopted.

The Secretary reported the membership as follows: Honorary members, 20; active and associate members, 84; student members 17, or a total of 121. The Association's cash prizes for original papers contributed to the proceedings in 1896 had been awarded, the first to Mr. Raoul Green, B.A., Sc. (McGill), for his paper entitled, "Notes on the Eustis Mine, Quebec," and the second prize to Mr. W. Morton Webb, B.A., Sc. (also McGill), for his paper on "The Petrolia Oil Industry."

NEW MEMBERS.

The following new members were elected:—

Mr. John E. Hardman, S. B. M. E., Montreal.
Mr. H. E. C. Carry, C. & M. E., Toronto.
Mr. Lionel H. Shirley, M.E., Montreal.
Mr. W. Barclay Stevens, Montreal.
Mr. S. J. Simpson, Montreal,
Mr. George McDougall, Montreal.
Hon. C. C. Colby, Stanstead.
Mr. James F. Lewis, Chicago.
Mr. Charles Ramos, Barkerville, B.C.
Mr. J. W. Pyke, Montreal.
Mr. B. F. Peacock, Montreal.
Mr. J. D. Sword, M.E., Rossland, B.C.
Mr. Henry Bragg, Montreal.
Mr. J. Stevenson Brown, Montreal.

FINANCIAL STATEMENT.

Mr. A. W. Stevenson submitted detailed statement of the finances of the Association, showing :—Receipts, $1,301.74 ; disbursements, $1.019.34 ; leaving a cash balance in hand of $282.40.

The Chairman.—This statement is certainly very satisfactory, and compares most favorably with the reports of similar organizations

The report, on motion, was duly adopted.

ELECTION OF OFFICERS, 1897-98.

PAST PRESIDENTS.

Hon. George Irvine, Q.C., (Johnson's Asbestos Co.,) Quebec.
Mr. John Blue, C. & M. E., (Eustis Mining Co.,) Capelton, Quebec.
Capt. Robt. C. Adams, (Anglo-Canadian Phosphate Co.,) Montreal.

PRESIDENT.

Mr. George E. Drummond, (Canada Iron Furnace Co.,) Montreal.

VICE-PRESIDENTS.

Mr. James King, M.L.A., (King Bros.,) Quebec, Q.
Mr. H. A. Budden, (Intercolonial Coal Co.,) Montreal.
Mr. W. A. Allan, (Kootenay and Columbia Prospecting and Mining Co.,) Ottawa.
Mr. John E. Hardman, S.B.M.E.. Montreal.

TREASURER.

Mr. A. W. Stevenson, C.A., Montreal.

SECRETARY.

Mr. B. T. A. Bell, (Editor Canadian Mining Review,) Ottawa.

COUNCIL.

Mr. Georgs R. Smith, (Bell's Asbestos Co.,) Thetford Mines, Quebec.
Mr. John J. Penhale, (United Asbestos Co.,) Black Lake, Quebec.
Mr. R. T. Hopper, (Anglo-Canadian Asbestos Co.,) Montreal.
Mr. Feodor Boas., (Danville Asbestos and Slate Co.,) St. Hyacinthe, Quebec.
Mr. Dwight Brainerd, (Hamilton Powder Co.,) Montreal.
Mr. C. H. Carrier, (Carrier, Laine & Co.,) Levis. Quebec.
Mr. H. W. DeCourtney, (Jas. Hutton & Co.,) Montreal.
Mr. Milton L. Hersey, B.A. Sc., Montreal.
Mr. S. P. Franchot, (Villeneuve Mica Co.,) Buckingham, Que.

DELEGATES TO FEDERATED INSTITUTE.

Mr. George E. Drummond, Montreal.
Mr. John Blue, C. & M. E., Capelton, Que.
Mr. John J. Penhale, Black Lake, Que.
Mr. R. T. Hopper, Montreal.

INVITATION TO VISIT THETFORD MINES.

Mr. George R. Smith, Manager of the Bell's Asbestos Co., extended an invitation to the Association to hold its summer meeting at Thetford Mines.

On motion of the Secretary, Mr. Smith's invitation was accepted with thanks.

VOTE TO THE SECRETARY.

On motion of the Treasurer, the Secretary was unanimously voted the sum of two hundred dollars, as an honorarium for his services.

This being all the business, the afternoon session adjourned.

EVENING SESSION.

The members re-assembled at eight o'clock, Mr. George E. Drummond, President, in the chair.

The Chairman expressed his pleasure at the presence of so many students, and welcomed, particularly, Dr. Goodwin and his party from the School of Mining, Kingston, and Dr. Porter, and the students from McGill.

STUDENTS' COMPETITION.

The following papers were then read by students for the cash prizes donated by the Association :—

"THE MISPICKEL GOLD ORES OF THE MARMORA DISTRICT"
By Mr. J. Walter Wells, School of Mining, Kingston.
"NOTES ON ASBESTOS MINING AT THETFORD, QUE."
By Mr. H. N. Thompson, McGill University, Montreal.
"GOLD MINING IN THE YUKON DISTRICT"
By Mr. W. M. Ogilvie, McGill University, Montreal.

PRESENTATION TO THE TREASURER.

MR. B. T. A. BELL.—I rise, Mr. Chairman, with a great deal of pleasure to perform a very pleasant duty. I have been asked, on behalf of the members, to express their very cordial appreciation of the splendid services rendered the Association since its inception, six years ago, by the gentleman who has presided with so much success over our finances,—our good friend, Mr. A. W. Stevenson (applause). On Mr. Stevenson, a busy man at all times, has fallen the onerous, and oftentimes none too pleasant, duty, of providing the "sinews of war," without which we could not have reached the prominent position our Association has attained ; that he has succeeded is amply demonstrated by a reference to the annual statements of our accounts. We have purchased a very handsome oak cabinet of silver and chinaware, which we beg he will accept in the true spirit in which it is given, as a slight token of our great appreciation of his services, and of the good will of all our members (applause).

MR. A. W. STEVENSON.—Mr. President, Mr. Secretary and Gentlemen, I have to thank you very sincerely for your very handsome testimonial, and for the very kind and flattering remarks that have been made. I must say, however, that whatever I have done for the Association has always been a great pleasure to me. I do not take as much credit to myself as you have given me in connection with the work of the Association. I must say that we have been fortunate in having with us a body of men with one common interest, and who, one and all, have worked unselfishly towards the development of our mineral resources, and the expansion of legitimate mining operations in our province. Believe me, gentlemen, I sincerely appreciate the kind thoughtfulness that has prompted this very handsome testimonial of your appreciation and good-will. (Applause.)

THE PRODUCTION OF CHROMIC IRON IN QUEBEC.

MR. J. OBALSKI.—The shipments by the Q.C.R. for 1896 amount to 2,108, as follows :—

	Tons.
To Philadelphia	750
" Pittsburg and vicinity	1,232
" Other points	126
	2,108

The value of above at the mine being about $26,000. It should be remarked that the ore sent to Philadelphia is high grade (50 per cent. and over) used for manufacturing of bichromates. The ore sent to Pittsburg is low grade (40 per cent. and a little over) for refractory bricks and lining of furnaces. A very small quantity is used for producing ferro chrome.

Until now our principal market has been in the United States, but I think as profitable as one could be found in Great Britain. The prices are the same as last year, viz., $18 for 50 per cent. and $8 to $12 for 40 to 44 per cent. f.o.b. car of the Q.C.R. About 60 men are employed by this industry.

The total production up to date should be read as follows :—

	Tons.
Shipped previous to 1894	50
" in 1894	915

	Tons.	
" in 1895	2,837	
" in 1896	2,108	
Total shipped	5,910	5,910
On hand ready for shipment (over the half being high grade) about		1,100
Total production		7,910 gross tons.
Or, in round numbers		7,000 "

There is no progress to report in the way of mining chrome ore, no machinery of any kind being yet used. The future of such an industry lies in the concentrating of inferior grades, which would enable our district to supply the bichromates manufacturers with a uniform high grade product.

THE PRODUCTION OF COPPER AND PYRITES.

MR. JOHN BLUE.—Pyrites mined in the Province of Quebec for the year 1896, 30,200 tons of 2,240 lbs., out of which shipments to the United States of green ore were 21,100 tons ; and treated in Canada—that is sulphur extracted and residue converted into mattes, 9,100 tons.

The year's output represents a quantity of 2,200,000 lbs. of pure copper, all of which was refined in the States.

The number of men employed in mining and dressing ores averaged 220 per day ; work carried on the whole year except legal holidays.

Wages paid for the year approximated $85,000,00.

MR. BELL.—It is worthy of remark that our enterprising friend, Dr. Reed, has re-opened the old Harvey Hill copper mine at West Broughton, and made several shipments during the past year. I am sure we all wish him success in his venture (hear, hear).

GOLD MINING IN QUEBEC.

MR. JOHN HARDMAN.—The gold industry of Quebec cannot be said to have made substantial advancement during 1896.

Work of a more or less desultory character was carried on in four localities in Beauce County, with a resulting production of about $1,300. More or less work of a prospecting character was done in Ditton, near the Pope mine, and washing was carried on at Rowe's Brook, these two localities producing by estimate something over $600.

At Dudswell, however, some systematic work was begun by the Roderique Company, who are reported to have produced about $3,000.

There is no definite prospect of increased work the coming year.

The total production of Quebec may be estimated at from $5,000 to $6,000 for the year.

Nothing has been done in quartz mining, which remains as heretofore.

THE PRODUCTION OF ASBESTOS.

The Secretary.—Mr. Penhale, who was to have submitted a review of this industry, is unfortunately unable to be with us, but the figures furnished to me officially may perhaps be of interest.

	Tons.	
Black Lake	996	*via* Quebec Central Railway
Thetford Mines	4,640	do
Broughton	63	do
Danville	4,939	Grand Trunk Railway.
Ottawa County	172	Ottawa & Gatineau Valley.
Pointe au Chene	784	
Total asbestos all grades shipped in 1896	11,594	

THE PRODUCTION OF MICA AND FELDSPAR.

The Secretary.—The exports of mica from the port of Ottawa during the year amounted to 378,958 lbs. Several shipments were also made from other ports, but the total value of exports from the province for the year, it is estimated, did not exceed $80,000. At Templeton station a feldspar mine was opened, and 560 tons shipped to the United States for the manufacture of pottery.

GRAPHITE MINING.

The Secretary —Several mines were worked in Ottawa County for the production of graphite. Mr. Brummell, who was to have dealt with this section is, however, not present, and I am unable to give the figures.

REVIEW OF THE IRON INDUSTRY.

The President then read his paper, reviewing the pig iron industry in 1896, a full report of the paper being given elsewhere. This closed the proceedings, and the meeting adjourned at eleven o'clock.

Sixth Annual Meeting.

HALIFAX, 10th MARCH, 1897.

The annual meeting of the members of the Mining Society of Nova Scotia was held in the Halifax Hotel, Halifax, on Wednesday, 10th March, the following among others being present :—

Graham Fraser (Nova Scotia Steel Co.) New Glasgow ; H. S. Poole, M.A., A.R,S.M. (Acadia Coal Co.) Stellarton ; R. H. Brown, M.E. (General Mining Association) Sydney Mines ; Major R. G. Leckie, M.E. (Dufferin Gold Mining Co.) Torbrook ; Major R. G. Leckie, B.A.Sc. (Torbrook Iron Co.) Torbrook ; G. E. Francklyn (General Mining Association) Halifax ; A. A. Hayward (Golden Lode Mining Co.) Halifax ; Clarence Dimock Wentworth Gypsum Co.) Wentworth ; W. L. Libbey (Brookfield Mining Co) North Brookfield ; W. A. Sanders (Lake Lode Gold Mine) Caribou ; C. F. Andrews (Richardson Mining Co.) Isaac's Harbour ; C. A. Meissner (Londonderry Iron Co.) Londonderry ; Charles Archibald, M.E., Halifax ; C. E. Willis, M.E. (Halifax Chrome Co.) Halifax ; J. T. Burchell (Cape Breton Colliery) New Campbellton ; T. R. Gue (Acadia Powder Co.) Halifax ; B. C. Wilson (Acadia Powder Co.) Waverly ; Geoffrey Morrow, Halifax ; A. Dick, C. & M.E., Halifax ; W. C. Brine, Halifax ; C. C. Starr, Halifax ; W. Blakemore, M.E. (Dominion Coal Co.) Glace Bay ; Hon. David McKeen (Dominion Coal Co.) Halifax ; Joseph Austen (Austen Bros.) Halifax ; J. E. Hampson (Ingersoll Rock Drill Co.) Halifax ; H. M. Wylde, Halifax, *Secretary ;* B. T. A. Bell (Canadian Mining Review) *Hon.-Sec.*

The meeting was called to order at half past ten o'clock in the forenoon, Major R. G. Leckie, President, in the chair. The Secretary submitted the minutes of the previous meetings, which were on motion adopted. Mr. J. E. Hampson was elected a member.

FINANCIAL STATEMENT,

The Secretary submitted the following statement of the finances of the Society :—

Receipts.

Canadian Mining Review half Stenographer's, etc., 1895	$ 7.50
Sale of old furniture	8.85
Grant from Provincial Government	500.00
Interest	1.10
Subscriptions collected	830.00
Balance due Secretary-Treasurer, 1st March 1897	88.44
	$1,435.89

Expenditures.

Balance due Secretary-Treasurer, 1st March, 1896	$ 240.41
Rooms, rent, etc	364.60
Canadian Federated Institute assessments	249.55
Canadian Mining Review subscription members	158.34
Meetings, guests, etc	121.15
Printing	11.75
Canadian Mining Iron and Steel subscription 1896	4.00
Postage, expressage, telegrams, etc	36.09
Secretary-Treasurer's salary, 1896	250.00
	$1,435.89

Audited and found correct.

(Signed),

H. S. Poole, } *Auditors.*
C. E. Willis, }

THE CANADIAN SOCIETY OF CIVIL ENGINEERS' BILL.

MR. B. T. A. BELL—I daresay most of the members are aware by this time of an impertinent piece of legislation promoted by the Canadian Society of Civil Engineers, entitled "An Act Concerning Civil Engineers," a measure which had lately been submitted to the Provincial Legislature, and which he was glad to learn had, on the representations of the society, been considerably modified, in so far as it related to the practice of the mining profession in the Province. There had been some correspondence in the local papers on the subject between Mr. Hardman, their late president, and Mr. Dodwell, and Mr. Hardman had asked him to read the following communication to the members :—

"As circumstances unavoidably prevent me from attending your annual meeting, I am obliged to take this method of bringing before the society, a subject upon which I very much desire their consideration, viz: the bill recently introduced into the legislature to regulate the practice of the engineering profession.

In this connection it is extremely probable that most of the members have seen my letter upon the subject sent to the *Halifax Herald*, and also the letters on the same subject from a Mr. Dodwell and Prof. Butler of Queens College, and it is also most probable that the active members of the society have already given the matter much thought. I desire briefly to say that Mr. Dodwell's long article failed to point out the "illogical" part of my letter, and that more than two years ago I was urged to join the Canadian Society of Civil Engineers by one of our own highly respected members, Dr. Martin Murphy, who prepared the necessary papers for me. Upon investigations of the published transactions of the society, I declined the honor, for the logical reason that the papers presented did not bear upon mining or metallurgical work, and hence were not of a value of $20.00 per year to me.

Because the men who drafted the by-laws of the Canadian Society of Civil Engineers chose to define a civil engineer as a "mechanical, mining and electrical" engineer also, does not in the least make their definition binding nor authorative, nor does it show in 1887 much knowledge of the relative status of the different engineering professions. The same by-law also includes "military" works, while a few paragraphs below Mr. Dodwell says the "first and obvious meaning of a civil engineer was one who was not a military engineer." But passing by the personalities of Mr. Dodwell's letter, for personalities are not arguments, it is a manifest untruth to say that the "bill was pretty thoroughly discussed in committee of the House of Assembly," as no representative of the mining, mechanical or electrical end of the "civil engineering" profession was present, with the exception of Mr. Alexander Dick, of Halifax, nor is it complimentary to Montreal to call that city "the highways and hedges," nor to allude to Messrs, Gue *et al* as having "scoured" therefrom.

The essence of the bill, as Mr. Dodwell states, is really to give a duly qualified engineer a recognized status, and, if that were all, no exception could be taken to it; but it is altogether a different matter to impose a tax of $20 a year, solely for the benefit of the treasury of the Canadian Society of Civil Engineers. Let the tax, if one must be paid, be paid, in the case of mining men, into the treasury of the Nova Scotia Mining Society. Let the government appoint the examining committee from men in the province, who are recognized as competent mining engineers, and let a degree in an engineering profession, from a technical school of standing, be accepted in lieu of an examination.

This bill (Sec. 5, par. E.) accepts only degrees from British or Canadian universities. Why are American universities shut out, whose technical schools are admittedly ahead of any British or European schools?

In February, 1895, Mr. Wm. Mather, M.P., President of the Association of Technical Institutions in Great Britain, in his annual address in London, said of the Massachusetts Institute of Technology, that it was the best model for scientific schools in his own country, and that "the conspicuous practical knowledge of the students, their thoroughness and power of adaptation and resource they possess, in entering workshops and manufactories, railroads or mines, public works and constructive engineering; all these fruits of their training are, as far as I have seen, not equalled on the continent."

But coming down from this position, every capitalist, every man of business, every man of experience, knows how frequently he has gotten his best advice, not from men with letters after their names, but from men who have learned their business practically, who have pounded the drill, have scratched with the awl and square, or have tapped the slag from the metal.

Yet any such competent, practical man, by this bill is shut out from giving his advice when asked.

That a large number of totally incompetent men are advising, reporting and drawing fees as mining engineers, is a fact to be deplored, and corrected if possible, but it must not be forgotten that the mining engineer occupies a very different field to the civil, mechanical and electrical engineer.

To quote from an authority, "in many branches of engineering the engineer, while he has great responsibility, is in a sense working in plain sight and with plain facts. Unless he is dishonest or utterly incompetent, he is carried along by his work and his facts to what is, approximately, at least, the proper solution of the problem at hand. With the mining engineer the case is different; the whole question of ore deposits is one of uncertainty. The science is yet in its infancy, and at best can never be made the subject of exact laws, like those of most other matters considered by "engineering," and experience backed by training governs the skill and standing of the mining engineer with his clients.

Therefore, in approaching this subject, as the engineers of both Great Britain and the United States have done, there has never as yet appeared a satisfactory solution, and the simile of the lawyer and doctor becomes a false one. At the Montreal meeting of the Federated Canadian Mining Institute, one of the cleverest lawyers in the Dominion, a counsel for the C.P.R., stated that he did not see how it could be made practicable to have mining experts and engineers formed into an incorporated body, and placed in such a position as to be responsible to to the public.

Prof. Butler's letter needs no comment, as he has himself, when president of a mining company, seen fit on several occasions to pay me a fee and ask my advice in mining matters.

Let me remove, however, from his mind one erroneous impression, viz., that Canadian mining engineers are going to hurry up to become members of the Canadian Society of Civil Engineers. Besides myself, I can name several M.E's who have declined membership; amongst others, Mr. John B. Hobson, of British Columbia, who is doing work that no member of the Canadian Society of Civil Engineers has had the experience to do.

Furthermore, from the report of the January meeting of the Canadian Society of Civil Engineers, it would appear that a very earnest discussion on the merits of this bill took place. It is to the credit of many of the members, foremost amongst whom was Mr. P. A. Peterson, chief engineer of the C.P.R., that exception was taken to asking English or American engineers to pass an examination before practising in this country. It is noteworthy, too, that the profession as represented by our chief technical school (McGill) took no part in the discussion.

I desire to submit to the Society a resolution, to the effect that a committee of its members be appointed:—

(1.) To take this matter into consideration:

(2.) To formulate a desirable bill without the objectionable features of revenue to an outside society:

(3.) To confer with the Nova Scotia representatives of the Canadian Society of Civil Engineers, and so far as possible to co-operate with them in the matter, insisting on the broad distinction that lies between a mining engineer and a civil engineer:

(4.) To confer, if necessary, with the Hon. Attorney General, or other legal talent, on the matter:

(5.) To confer with similar committees that may be appointed by the Mining Associations of Ontario, Quebec and British Columbia.

(6.) To submit a report at the next regular meeting of this Society.

I submit these resolutions, in the hope that discussion will ensue, and more for the purpose of arousing intelligent discussion than in the hope that these particular resolutions may be adopted. To those members who are interested in procuring foreign capital for our mines I need not point out the detrimental features of the bill referred to in this letter. They are self-evident upon perusal.

Regretting exceedingly that I am unable to be present to urge by my voice, rather than by my written word, the importance of this subject,

I am, yours truly,

JOHN E. HARDMAN.

Mr. Bell.—It seems to me that such a resolution as that proposed by Mr. Hardman should be endorsed by this Society. It is very likely that legislation of a similar character will be promoted in the other provinces, and I need not say that any such will meet with a vigorous opposition from the Federated Canadian Mining Institute.

The Chairman.—When this matter was brought before the Legislature here I had not returned from Montreal, but I believe a deputation interviewed the Attorney-General and the other members of the Legislature.

Mr. Gue.—It is quite safe to say that it will never become law while this province has a Legislative Council.

Mr. Hayward.—I have received assurance from members of the Council that it will never pass.

Mr. Archibald.—In regard to any similar bill being proposed in Ontario, we could, by passing the resolutions suggested, give our friends there our moral support.

Mr. Blakemore.—The best thing to do is to support the action of the Federated Institute, but I am in favor of a committee being appointed to look after such legislation in so far as it relates to our own province. I would therefore move the appointment of a committee.

Mr. T. R. Gue having seconded, the following committee was appointed, with power to add to their number: Major Leckie, C. E. Willis, H. S. Poole, C. F. Andrews and A. A. Hayward.

The following resolution was also adopted:—That this Society condemns the clauses of the bill promoted by the Canadian Society of Civil Engineers, in so far as they relate to the practice of mining engineering; further, that the Society endorses the action of the Federated Canadian Mining Institute, in taking action to defeat the measure in Nova Scotia and the other provinces of the Dominion.

THE PRESIDENT'S ADDRESS.

Major Leckie.—The Geological Survey of Canada has, with commendable promptness, issued its annual statement of the mineral production of the Dominion. In the year 1896 minerals to the value of $23,627,305 were mined or quarried. This is an increase of $11,627,305 over the year 1895, or an increase of one hundred per cent. in ten years,—quite a satisfactory showing, and the probability is that the proportionate increase during the next decade will be fully as great.

In our own province, the report of the Department of Mines shows a gratifying increase in the production of coal and gold. The total quantity of coal mined was 2,235,472 tons, of which 2,047,133 were reported sold, an increase in ten years of 673,472 tons, or nearly fifty per cent. In coke, an increase of fully forty per cent. is reported, which will be still further added to by the new works just started on the North-West Arm. These works our members had the privilege of visiting at the December meeting, but while yet in an incomplete condition. The plant represents a thoroughly up-to-date practice, in which every detail has been thoroughly worked out, with a view to securing the greatest efficiency and economy. The utilization of the gas and by-products, which must constitute a large source of income, will be watched with great interest, both from a technical and financial standpoint.

The yield of gold was 25,596 oz. 14 dwt. 6 grs., which at $19.50 per oz. equals $499,156.00, to which should be added nuggets and mortared gold, which would bring the total production well over half a million dollars. The province has thus furnished enough gold, equal to the resources of all the banks in Nova Scotia. To produce this quantity of gold, 65,873 tons of ore were crushed, which yielded 7 dwts. 18½ grs. per ton ; but taking into consideration the loss of gold by inferior milling practice, as well as that carried away in the tailings and capable of being recovered, the value may be reckoned as fully 10 dwts. per ton. In 1867, the year of the largest production, 31,386 tons yielded 27,314 oz. gold, or an average of nearly 17½ dwts. This marks a healthy progress towards working larger quantities of low grade ores at lower costs. It is well known that many large bodies of quartz, or quartz and slate forming interlaminated bands or belts, carrying from two dwts. to five dwts. or more per ton, exist in several districts of this province. These are continuous for a considerable length, and to unknown depths. They cannot be easily lost by faults, and can be mined very cheaply, either by open-cast or underhand stoping. Improved mechanical appliances, together with the use of high explosives, have revolutionized quartz mining. Equal, if not greater, improvements have been made in the milling, by the introduction of rock-breakers, self-feeders, belts or vanners, for concentration of sulphurets, and improved chemical methods and apparatus for the extraction of the precious metals from these sulphides.

A most interesting and valuable paper was read at the Montreal meeting of the Federated Canadian Mining Institute by one of our members, Mr. C. F. Andrews. In it he stated that at the Richardson mine he had reduced the cost of mining, milling and general charges to $1.65 per ton. This, under conditions existing there, is equal to the best work done anywhere else in the world. Similar belts, if carrying only $2.00 per ton, will leave a small margin for profit.

Although there are many rich leads, small and of varying size, which will pay well to work, yet it is the larger bodies of low grade ore, skilfully and economically worked, upon which the gold industry must depend for profits and permanency.

Every mill, however small, should have a concentration plant, but few mines in the province have an output sufficient to justify the erection of extraction works, for either the chlorination or cyanide process. It is rather highly desirable that suitable works be erected at some convenient and central point, where the smaller operators could send their concentrates for treatment or sale. Such a work the provincial government could well afford to subsidize liberally, as the result would be an increase in the royalty upon gold, which is at present entirely lost in the tailings.

The enterprise and courage of Mr. Libbey and his associates displayed in the erection and operation of a complete concentration and chlorination plant, have been rewarded, I am delighted to learn, with complete success. This is a most important step in the gold mining industry of the province, and we may look forward to a most interesting paper from Mr. Libbey at our next meeting.

The meetings in Montreal of the Federated Canadian Mining Institute, on the 3rd, 4th and 5th of last month, were highly successful from every point of view. The attendance was large and representative. From the universities and mining schools came men of the highest scientific attainments ; the late director, and present chief, of the Geological Survey, with members of the staff, contributed valuable and interesting information by papers and discussions. Our mining engineers and those interested in the industry displayed the greatest interest in the proceedings, and by their practical knowledge and aid made the meetings an unqualified success. The contingent from our own Society was much in evidence, and creditably represented the province. The aid which the able representative of the Department of Mines gave us was of the greatest value. Our thanks are due to the government for its liberality in sending a marvellous exhibit of nuggets and gold bearing quartz, which excited the greatest interest, and called attention in an unmistakable manner to the great resources of Nova Scotia.

In view of the marked interest being taken in mining matters, and more especially in gold mining, the report of the Department of Mines for 1896 is very disappointing. That portion referring to the metalliferous mines, especially gold, is crude, badly arranged, and in every way defective. It is not such a Blue Book as one would feel like sending abroad to either a professional or business man. It has not even an index.

The Assistant Commissioner of Mines, although eminently qualified for the position, has too much to do, and is not provided with a qualified efficient staff. It is highly necessary that a thoroughly educated and trained engineer be appointed as inspector of metalliferous mines. He should have some knowledge of chemistry and metallurgy as well as surveying and mining A new or revised description of our gold districts is required, and an up-to-date report on the gold mines and progress of the gold mining industry. The competition for capital is keen, and it behooves the government of the province to arouse itself and be up and doing, even for the prospect of increasing its own revenues.

It may be worth while for this Society to consider the expediency of appointing a committee of its members to consider a Bureau of Information. A monthly bulletin might be issued, giving the latest information regarding the operations of mines, new discoveries, and other items likely to attract attention to the mineral resources of the province. Great care would have to be exercised in verifying statements and reports. This might take the place of the Chamber of Mines, which in other mining countries publishes statistical information and interesting facts regarding the mining industry (Applause.)

Mr. B. T. A. Bell.—The President's remarks call for some discussion. The suggestion of the publication by the Provincial Government of a series of bulletins dealing with special districts is a particularly happy one. British Columbia has adopted this practice with much benefit to the expansion of knowledge of her mineral resources.

Mr. Dimock heartily endorsed the remarks of the President in so far as they related to the Mine's Report. His own mine at Central Rawdon, although labour and other returns had been furnished to the Department, did not appear in the report at all. On bringing the matter to the notice of Dr. Gilpin, that gentleman had written to the effect that the Deputy had not visited the mine as he was under the impression that it was not being worked. He further stated there was no obligation to mention a mine in the Report except for infringement of the law, but that it had been customary for notices to be inserted ; that Central Rawdon had been unintentionally omitted, and and if I would give him a brief memorandum of the work done it could be embodied in the next annual report. The Society should enquire into the working of the Mine's Department and get it into a more perfect condition as soon as possible.

Mr. Dick.—Any committee appointed should ask the government to do more to interest outside capitalists in our gold mines. The Annual Report was a miserable, incomplete affair in comparison with those published by other Governments.

Mr. B. T. A. Bell.—It appears to me that Dr. Gilpin's hands should be strengthened by the appointment of a first-class metalliferous mining engineer, whose duty it will be to look particularly after the gold metal mining industries. The report of Dr. Hind dealing with the districts of Sherbrooke, Wine Harbor, and other gold mining sections of the province had demonstrated the utility of special reports of this character, and it should be the duty of such a mining engineer to continue the work so ably begun by Dr. Hind. Reports of this character, if properly illustrated with maps and views of the mines in operation, will do much to dispel the lamentable ignorance of the outside public respecting the present condition of the gold mining industry in Nova Scotia.

Mr. C. E. Willis endorsed the idea of illustrating the reports of the Department. The equipments of the collieries, furnaces, and many of their gold mines were unsurpassed, and photos of these undertakings should be shown.

Mr. A. Dick—The whole inspection of the gold mines last year occupied thirty-five days, twenty of which were consumed in driving from one to another, and fifteen in making enquiries from the manager at the pit head.

Mr. Andrews—I think the inspection of the mines by the Deputy Inspector simply a farce. At the Richardson he simply drove in and had a talk with the superintendent and drove out again.

Mr. Bell moved that the Society interview the Hon. Mr. Murray in a body on Thursday morning, and impress him with the urgent necessity of the improvements indicated on the lines of the discussion. The motion carried, and the Secretary was accordingly instructed to arrange for the interview.

ELECTION OF OFFICERS AND COUNCIL.

PRESIDENT :

Major R. G. Leckie (Dufferin Gold Mining Co.) Torbrook.

VICE-PRESIDENTS :

Graham Fraser (Nova Scotia Steel Co.) New Glasgow.
Wm. Blakemore (Dominion Coal Co.) Glace Bay.
Chas. Fergie, M. E. (Intercolonial Coal Co.) Westville, N. S.

HON. SECRETARY :

B. T. A. Bell (Editor Canadian Mining Review) Ottawa.

SECRETARY-TREASURER :

H. M. Wylde, Halifax,

COUNCIL :

W. G. Matheson, New Glasgow.
F. H. Mason, F.C.S., Halifax.
G. W. Stuart, M.E., Truro.
W. L. Libbey, N. Brookfield.
Chas. Archibald, M.E., Halifax.
Geoff. Morrow, Halifax.
J. T. Burchell, N. Campbellton.
B. F. Pearson, Halifax.
C. E. Willis, M.E., Halifax.

UNSYSTEMATIC METHODS OF GOLD MINING.

MR. C. F. ANDREWS.—I should like to occupy your attention for a few moments with some remarks on the systematic, or rather lack of systematic, mining of gold ores. We see too often the proverbial "hole in the ground," the hastily constructed shanty, dignified by the term "shaft-house," the trap of a plant, consisting of an engine, boiler and hoisting-gear, which, so far as its location and adaptability are concerned, might easily have been placed there by a whirl-wind. All this has cost the company money, and is likely to continue to do so, under the circumstances.

If the mine is of stout heart, and persists in refusing to be killed by its greedy and expectant owners, it may pay its way through the numerous changes of plant, the many stages of additions, the final demolition of its parts above ground, and the expense of re-building them. It may even stand having the particular mill, under the disadvantages of which it has to labor, erected upon it, from motives of false economy, its first cost being considered rather than its adaptability to the requirements of the mine. In this, I do not refer to any one mine in particular, but to the history of many mines, and, judging from the past history, which is stlll likely to repeat itself. And the cause of this,—well, in most instances, the cause may be found in the fact that the mine is not governed by a set of men who understand its requirements.

Its management, individually, in their own particular lines of trade or profession, may be the smartest and most successful men in the country. Too often their mining energy is displayed in attempting to kill the goose which they expect to lay for them the golden egg, by squeezing it. Yet it is hard to make them believe this. They have put their hands in their pockets and put up their money for a "plant," too often saying in their minds, like the old maid who was praying for a husband, "any old thing" will do. They have also given instructions to put up a "plant," and hurry along the gold. Nor is it always the fault of the owners—managers have been known to be as premature in their hurry for a "plant" as owners for their returns. However, the results have the same drawbacks in each case.

Meanwhile, let us take a look at the conditions below ground. If it is a new mine, we too often see a single shaft down a few feet, generally far enough to get enough solid rock to drive a tunnel on the load or belt, which may be showing considerable gold. We may also find that the lode has been exposed in a few places on the surface, for a hundred feet or so. Perhaps a tunnel has been driven both ways from the shaft, from twenty to one hundred feet on the lode. As likely as not, if the shaft is deep enough, you will find a drill already following up the men, working in the face of the tunnel, perhaps close against them, taking out a stope. It is of no consequence that they are in each other's way: there must be some quartz on hand when the new plant is ready for it, and the "plant" must start on time no matter what may happen afterward.

Every one connected with the property (who is not obliged to go below too often) is happy. Things are being pushed, a big crowd working, and the manager is able, from day to day, to plan his construction work, so that none of the carpenters are idle. He has not had time to get out, study, and correct his plans before the construction work was started, but he must have a place for his machinery when it arrives.

The directors, if they visit the place at all, see everything on the hum; even see the miners, who are driving the tunnel and sinking the shaft, hurrying on deck along with the stopers to avoid the shots the stopers have just set off. But presidents and directors are seldom supposed to know anything about this; they are satisfied,—"things are humming." And if the mine is fortunate enough to hold out, they are in a fair way to keep things humming rather than paying. With great luck—and expense—they manage to keep things working along this way for a couple of years or so.

Yes, "it is paying," and they are congratulating themselves; they always "knew that it would pay." They have made considerable additions to the plant, which was a little over-taxed; and the fuel bill is rather heavy for the amount of work accomplished. The strike of gold is found to be working away from the main shaft; it did not remain where first found. But the hoister and pump are, unfortunately, not endowed with the same power of apparent locomotion that has taken possession of the strike—they are left behind. After spending some three or four thousand dollars more to patch up the plant, it is finally considered inadequate, and a new one is decided upon and erected.

With the first plant it was costing four dollars a ton for mining and milling, and 25,000 tons of ore have been crushed. With the improved plant, installed in a rush, in order to avoid keeping the mill closed down any longer than the time set by the management, who have failed to profit by their previous experience, it is found that the cost has been reduced by one-half. But the plant, put in under these conditions, is yet far from perfect.

What better appeal than this can we make for a more systematic method of mining? In this supposed case (instances of which are not confined to this province alone, or to this Dominion, for we can find them all over this continent, particularly in some of the Southern States*), we can see the great saving which would have been effected had the last plant been adopted on the first instance. If, with this hastily constructed plant, the cost was reduced from four to two dollars per ton, the saving on the first lot of ore mentioned would have amounted to over fifty thousand dollars. Had that property been properly developed before any plant was erected, when the time came to work the mine the proper machinery could have been put in and located at the proper place, thereby, also, saving the cost of the first plant.

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* See Gold Mining in the Southern Appalachian States. Vol. XXV. Trans. Amer. Inst. of M.E. also, pages 1024 and 1025, same vol.

This is but one of the many cases which could be brought to illustrate the necessity of thoroughly developing and understanding a property before attempting to equip it. Unfortunately, many blunders in this line do not result so favourably as in the case which I have supposed, which I am sure you will not for a moment think is an overdrawn one. Nor would I have it supposed for a moment that I intended it as an illustration of an average case in mining,—I simply maintain that it does happen, and that too often ; and many good properties, to-day closed down, are without doubt, idle owing to similar occurrence.

MR. CHAIRMAN.—I listened with great pleasure to the paper which Mr. Andrews read in Montreal. What he has added to-day I think is pretty much the experience of most of us having to do with joint stock companies. As a rule when persons purchase a property they imagine they have a mine, and that all that must be done is to get out the ore, but a mine has to be constructed quite as much as a cotton factory. It requires time and money; and a very few of our gold mines that I know of have started in with either one or the other. The prospectors have had to develop and equip mines out of their own earnings, which means a handto mouth policy and a starvation one at that. It has already been a question of expediency, and as Mr. Andrews stated, " any old thing will do," the result being that very few of our mines are really properly equipped. The great advantages of starting with sufficient capital and with the investors understanding the clear conditions of the case, are that the property can be properly prospected before any permanent work is done and when the shaft is put down it is in its proper place.

MR. LIBBEY.—I would like to say a few words perhaps in criticism and somewhat in friendly advice too. In my experience around the Province I found that men built mills almost as soon as they discovered boulders. We all know the gold mill. It has a long slanting roof on one side and is generally placed at an inconvenient distance from the shaft. The mine I am working is a conspicuous example of the lack of common sense in the placing of the mill, which is flat on the ground, without a foundation under it. If the man who built that mill had exercised the same amount of common sense as he would in any other business he would have placed it over the main shaft, instead of fifty feet away. This is not an isolated case. With the exception of the mill at the Lincoln mine at Chester basin our new one is the only one I have seen placed over the shaft. Our new mill takes the ore from two leads. Some of the old gold miners said that it would be would be impossible to run two leads at the one shaft, but we are doing it. All these things conduce to cheap working.

MR. ANDREWS.—We may find circumstances under which it would be impossible to place the mill at the deck head. Sometimes there is a lack of water, and again, if the location is low you can't get rid of the sand without putting in an elevator.

MR. LIBBEY.—I can pump water with a steam pump cheaper than they can haul the ore with an ox and one man to drive it.

MR. FRASER.—I think that Mr. Libbey has thrown out a practical suggestion in regard to putting the mill close to the shaft. While people may think it does not cost much to haul ore half a mile, if accounts were kept properly, it would be found that there was considerable wear and tear. Of course there is one thing to be considered in putting the mill at the head of the shaft, you must know that you have enough ore to last for a considerable time, and in some cases it may be better to select a place for the mill a little distance away from the shaft. I think it does not make much difference what the business is you will find the directors want dividends. When I started in business it was with the suggestive name "steel and forge," making iron and steel for a living. (Laughter.)

MR. WILLIS.—I know two or three instances in which Mr. Libbey's idea was carried out. At Oxford sixteen years ago the ore was hoisted to the top floor, also at the Parker Douglas mine and at another mine in Oldham.

MR. SAUNDERS.—I have noticed in other countries failures in gold mining have occurred from too much haste to get out gold on the start. I believe that the first point is to raise money enough to open your mine, then your mine will guarantee further capital for putting in plant.

MR. HAMPSON.—My opinion is that a small good development plant should be erected at first in place of the large plants we usually see. I have seen plant which originally cost $82,000 standing idle for lack of materlal.. It would be far better if the miners found out what they had underground before erecting such a costly plant. You can always carry water cheaper than you can carry ore, and I think that Mr. Libbey is right to have the mill as close to the shaft as possible.

DELEGATES TO THE FEDERATED INSTITUTE.

The following were elected delegates to the Federated Canadian Mining Institute :—

Major R. G. Leckie, Torbrook.
R. H. Brown, Sydney Mines.
John Hardman, Sc. B., M.E., Montreal.
Charles Fergie, M.E., Westville.

The meeting then adjourned.

AFTERNOON SESSION.

The members reassembled at three o'clock, the President in the chair.

The following papers were read :—

"The Gold Bearing Tailings of Nova Scotia," by Mr. F. H. Mason, F.C.S., Halifax.

"A Review of the Commission on Mine Fires in Pictou County, N.S." by Henry S. Poole, M.E., A.R.S.M., Stellarton.

"The Mechanics of Mining," by D. W. Robb, M.E., Amherst.

"Mines and Mine Management," by Robt. Archibald, C. & M. E., Joggins, N.S.

The meeting adjourned at half-past five o'clock.

ANNUAL DINNER.

In the evening about thirty members sat down to an excellent dinner in the Halifax Hotel. The proceedings were entirely informal, only two toasts being given, viz., 'the Queen' and 'the health of the President,' both of which were loyally honored. Thereafter the evening was enjoyably spent, a number of excellent songs and instrumental selections being given. An amusing feature of the programme was the topical song by Mr. Ernie Wylde, containing the following verses relating to the Bill of the Canadian Society of Civil Engineers, and entitled :

"IN THE SWEET BYE-AND-BYE."

There's a certain affair the C. S. of C. E.,
    May it roast in the sweet bye-and-bye,
They were after our dollars through a local M.P.,
    And they'll wait till the sweet bye-and-bye ;
Their recent bold effort to gobble us in
And make us all C.E's. was rather too thin,
I tell you they never will survey *our* tin,
    Neither now, nor the sweet bye-and-bye !

And if they attempt to persist in their game,
Some day in the sweet bye-and-bye,
The C. I. of M. E. will attend to the same,
You bet, in the sweet bye-and-bye !
I just wonder how things would look in this light,
If we brought in a Bill to absorb them outright,
And arranged an exam. that would knock them out quite,
Would they kick—in the sweet bye-and-bye ?

With all due respect to our Government here,
Both now and the sweet bye-and-bye,
We humbly suggest that they don't lend an ear
To such schemes in the sweet bye-and-bye ;
For although a C. E. is all right, we admit,
And in planning a sewer may make quite a hit,
That his knowledge of mining is certainly *nit*
He will know in the sweet bye-and-bye.

British Columbia Association of Mining Engineers.

ANNUAL MEETING.

VANCOUVER, 13TH MARCH, 1897.

The adjourned annual general meeting of the members of the British Columbia Association of Mining Engineers was held in the Hotel Vançouver, Vancouver, on Saturday, 13th March. There was a large attendance. Mr. J. F. Bledsoe, of Alberni, in the absence of the President, being called to the chair. After the transaction of routine business the following officers were elected for the ensuing year :—

PRESIDENT :

Mr. S. M. Robins (New Vancouver C. M. & Land Co.) Nanaimo.

VICE-PRESIDENT :

A. H. Holdich (Hall Mines, Ltd.) Nelson.

SECRETARY :

G. F. Moncton, F.G.S., Vancouver.

TREASURER :

Col. T. H. Tracey, Vancouver.

COUNCIL :

Howard West, A.R.S.M., New Denver.
A. J. Colquhoun, M.E., Vancouver.
R. C. Campbell Johnston, Slocan Lake.
W. A. Carlyle, M.E., Victoria.
W. A McGregor, Nanaimo.
L. F. Warner, M.E., Quesnelle Forks.
John B. Hobson, M.E., Quesnelle Forks.
J. F. Bledsoe, Alberni.
J. D. Sword, Rossland.

A large number of new members, associates and students were elected.

An important resolution was moved by A. J. Colquhoun and carried unanimously to the effect that the Government be requested to open a mining record office for Burrard electoral district at Vancouver to be bounded northward by a line to be selected by the Government, for which the north side of Queen Charlotte Sound was suggested. A strong feeling in favor of affiliation to the Federated Canadian Mining Institute was shown, it having been proposed by the latter body. New Denver was decided upon as the next place of meeting, on or about June 1st.

SPECIAL MEETING.

Montreal, 7th May, 1897.

A special general meeting of the members of the Federated Canadian Mining Institute was held in the Windsor Hotel, Montreal, on Friday evening, 7th May, to consider certain items in the new Tariff. There was a good attendance.

Mr. George E. Drummond, President occupied the chair.

The Secretary having read the notice convening the meeting, submitted the following telegram from Major Leckie, President of the Mining Society of Nova Scotia :—" Am very strongly opposed to admitting Mining Machinery free. Mining industry has not greater claims than others to exemption. Entirely unjust to Canadian miners to admit American coke and ore free, and in addition pay two dollars bounty on their product. Export duty unjustifiable ; should be opposed most strenuously."

Mr. Hardman referred to the ambiguity in the phraseology of the old law, and pointed out that the new item was quite as liable to misinterpretation.

The Secretary.—It is evident from the wording of the item : " Machinery of a class *exclusively used and required for* mining," that it was the intention of the Government to give protection to the home manufacturers, as a large quantity of machinery used in mining was also applied to other industries, such as drills, compressors, hoisting engines, blowers, pumps, &c. It would prevent a repetition of friction and misunderstanding if the dutiable articles were clearly specified and everything else admitted free.

Mr. J. F. Lewis stated that a representative meeting of Canadian manufacturers had been held that afternoon, when a resolution was adopted asking the Government to specify for duty the following articles :—Ore and rock crushers, stamp mills, Cornish and belted rolls, rock drills, air compressors, and precussion coal cutters. The list was an exceeding modest one, and it was hoped it would receive the support of the Institute. If all mining machinery were admitted free, his company would simply shut down their Canadian works, and ship their drills and compressors from the other side.

MR. WM. HAMILTON (of the Hamilton Manufacturing Co.) stated that during the past year his company had gone to considerable expense in fitting up their works at Peterborough, for the construction of special lines of mining machinery under the E. P. Allis Company's patents. The introduction of free mining machinery would entail a very serious loss to his company.

After further discussion :—

MR. JOHN E. HARDMAN, S.B., M.E., moved :—

Whereas the items relating to mining machinery in the tariff just superseded were susceptible of misinterpretation by the different collectors of customs, thereby creating annoyance and delay in passing entries ; and whereas the language of item 535 of the present tariff is likewise susceptible of misinterpretation ; be it resolved that the Federated Canadian Mining Institute respectfully suggests to the Federal Government the advisability of re-constructing this item, to read as follows :

(a) That ore and rock crushers, stamp mills, Cornish and belted rolls, rock drills, air compressors, and percussion coal cutters be specially enumerated as dutiable ;

(b) All tools, machines or appurtenances to be used exclusively for mining, milling, smelting, reducing or refining, or materials used in the construction of the same, n. e. s., Free :

Mr. John F. Stairs, seconded.

The motion was carried unimously.

The question of the provision in the tariff for an export duty on iron and steel made from Canadian ore was next considered, and after discussion :—

Mr. A. W. Stevenson moved, seconded by Mr. Jas. S. Mitchell,

Resolved,—That the members of the Institute respectfully urge upon the Federal Government the necessity of cancelling the clause relating to the imposition of an export duty on iron and steel made from Canadian ore and fuel, fully believing that such an export tax would prevent the full development of our iron mines and industries which the proposed bounties are meant to encourage.

The motion was carried unanimously.

The Secretary having intimated that the Minister of Finance and the Controller of Customs would receive a deputation from the Institute on Saturday, it was decided to send a deputation to Ottawa on this date.

DEPUTATION AT OTTAWA—MINISTERS ASK FOR A FREE LIST.

A large deputation from the Institute visited Ottawa on Saturday, 8th May, a special coach being attached for their convenience to the morning train, Canada Atlantic Railway.

The Hon. Mr. Paterson, Controller of Customs, granted a hearing to the deputation at three o'clock in the Russell House, after which the party was received by the Hon. W. S. Fielding, Hon. Mr. Mulock, and the Hon. Mr. Paterson in the office of the Finance Minister. The views of the Institute were clearly and forcibly presented by the Secretary, who submitted the resolutions adopted by the Institute. Mr. Jas. F. Lewis representing the manufacturers, also addressed the Ministers. At the request of the Finance Minister, a provisional list of machinery and appliances to be admitted free of duty when for use in mining was prepared and submitted as follows :—

FREE LIST.

All pipes of wrought iron above 2 inches (butt or lapp-wedded) and used exclusively in mining.

Pressure or exhaust fans for ventilating mines, exclusive of power.

All coal cutting machines except precussion coal-cutters.

All machinery for coking ovens.

Stanley and other coal-heading machines.

Miners' safety lamps.

Coal augers and rotary coal drills.

Diamond and all other core drills.

Machinery used in the washing and dressing of coal.

All electric or magnetic machines for the separation or concentration of iron ore.

Drying or ore roasting machinery.

Blast furnace blowing engines and all rotary pressure blowers.

Blast furnace water jackets.

Jigs, classifiers, separators, buddles.

Slime tables, vanners.

Amalgamating and settling pans used for ore dressing.

Ball grinding machines.

Machinery for the extraction of the precious metals by the chlorination or the cyanide processes, excepting power.

Copper plates, electro-plated or otherwise, for use in reduction works.

Automatic samplers for ores containing precious metals excepting power.
Amalgam safes.
Retorts.
Automatic feeders.
Amalgam cleaners.
Mercury pumps.
Bullion furnaces.
Bessemer and other convertors for iron and copper ores.
Briquette making machines for fuel and ore.
Sheet-iron pipes monitors, giants, and elevators used in hydraulic mining.
Pyrometers, guages, (spring and mercury) used in furnace work.
All safety appliances for mining.
All materials imported for the manufacture of the above machinery.

(Signed) GEO. E. DRUMMOND, *President*,
Federated Canadian Mining Institute.
B. T. A. BELL, *Secretary*,
Federated Canadian Mining Institute.
JAMES COOPER, *Chairman*,
Committee of Canadian Mining Machinery Manufacturers.
J. M. JENCKES, *Secretary*,
Committee of Canadian Mining Machinery Manufacturers.

J. E. HARDMAN,
JNO. J. PENHALE,
Members Mining Committee.

J. F. LEWIS,
WM. HAMILTON,
Members Manufacturers' Committee.

A GRANT TO THE INSTITUTE.

THE SECRETARY then submitted for the consideration of the Government an application for an annual grant of $2,000 towards the work of the Institute. The publications embraced a variety of subjects relating to the resources and mineral development of the country, and were of great value in directing attention to the Dominion as a field for investment. Similar grants had been made to the Royal Society of Canada and the Canadian Art Association, and the Institute, representing, as it did the best talent in the mining profession of Canada, was no less worthy of their recognition. If the grant was made, a portion of it would be applied towards the equipment of the Commercial Mining Museum in Montreal.

The Ministers having promised to give consideration to the representations of the Institute, the deputation withdrew well pleased with their reception.

ORGANIZED
1894

FOURTH ANNUAL MEETING.

Toronto, 31st March, and 1st April, 1897.

The fourth annual general meeting of the members of the Ontario Mining Institute was held, by courtesy of the Ontario Government, in the Railway Committee Room, Parliament Buildings, Toronto, on the evenings of Wednesday and Thursday, 31st March and 1st April.

There was a good attendance, Mr. J. J. Kingsmill, Q.C., president, in the chair.

Mr. B. T. A. Bell, secretary, read the minutes of the previous meeting, and submitted a verbal report of the work of the Institute during the year, which was adopted.

Mr. T. W. Gibson, treasurer, followed with a statement of accounts, showing a cash balance on hand of $71.37. The statement was, on motion, adopted.

ELECTION OF OFFICERS.

The meeting then proceeded to elect the following officers and council for the ensuing year, as follows:

PRESIDENT:

Mr. J. J. Kingsmill, Q.C., Toronto.

VICE-PRESIDENTS:

Mr. James McArthur, (Canadian Copper Co.), Sudbury.
Mr. John F. Caldwell, (Sultana Gold Mine) Rat Portage.
Mr. John Leechman, A.R.S.M., (Regina Mine), Rat Portage.
Mr. W. Hamilton Merritt, A.R.S.M., F.G.S., Toronto.

Treasurer:

Mr. T. W. Gibson (Bureau of Mines), Toronto.

SECRETARY:

MR. B. T. A. BELL, (Editor Canadian Mining Review), Ottawa.

COUNCIL:

MR. F. S. WILEY, (Saw Bill Lake Gold Co.), Port Arthur.

MR. J. BURLEY SMITH, C. & M. E., (Burley Gold Mining Co.), Rat Portage.

MR. G. R. MICKLE, M.E., (School of Practical Science), Toronto.

DR. A. P. COLEMAN, (School of Practical Science), Toronto.

MR. A. BLUE, (Director of Mines), Toronto.

MR. A. J. G. SWINNEY, (Canadian Gold Fields, Ltd.), Deloro.

MR. HERBERT C. HAMMOND, (Osler & Hammond), Toronto.

MR. J. H. CHEWITT, C.E., (Foley Mines Co.), Toronto.

AUDITOR:

MR. THOMAS SHORTISS, Toronto.

NEW MEMBERS.

The following gentlemen were elected members of the Institute :—

Prof. E. B. Shuttleworth, Toronto ; H. W. Kennedy, Rat Portage ; M. Koppelman, Toronto ; Major Harstone, Toronto ; W. Smaill, M.E., Rat Portage ; F. A. Schrietendorff, Toronto ; Dr. James Musgrave, Toronto ; Thos. Musgrave, Cork, Ireland ; C. H. Waterous, Brantford ; J. McAree, O.L.S., Rat Portage ; E. Bristol, Toronto ; J. E. Hardman, M.E., Montreal ; S. C. Duncan Clark, Toronto ; A. T. Anderson, Toronto ; A. J. G. Swinney, Deloro ; H. W. De Courtenay, Montreal ; E. B. Haycock, Ottawa ; A. Jarvis, Toronto ; J. Cotterill, Toronto ; W. R. White, Q.C., Pembroke ; J. Leechman, M.E., Rat Portage ; E. Strachan Cox, Toronto ; F. A. Hall, C. B. Jackes, S. R. Clark, G. Ritchie, W. H. Knowlton, S. R. Curzon, Thomas Davies and C. R. Clark, Toronto.

PLACE OF NEXT MEETING.

Some discussion was had as to the next place of meeting, various points being suggested. It was finally decided to leave the matter to be decided by the council.

RAT PORTAGE RESOLUTIONS.

The resolutions adopted by an assembly of citizens at Rat Portage on 10th September last, and referred to the Ontario Mining Institute for discussion at the present meeting, was then brought up for consideration. Resolution No. 1, calling upon the Ontario Government to extend all legitimate assistance in the development of the mining industry, was approved unanimously. On resolution No. 2, requesting the government to prepare and distribute free of charge maps of the Lake of the Woods gold districts :

Mr. A. Blue stated that some time ago the government had given directions for a map of the Lake of the Woods district to be prepared, with all mining locations laid down upon it to date, and this was now in course of preparation. This map would accompany the sixth report of the Bureau of Mines, and like all the reports of the Bureau, it would be distributed without charge.

Dr. Goodwin moved, seconded by Mr. W. R. White, Q.C., that the government be requested to prepare maps of the various mining districts up to date, for free distribution.—Carried.

On resolution No. 3, asking the government to appoint a mining land's agent at Rat Portage, and to establish a mining collection there :

Mr. James Conmee, M.P.P., stated he believed that provision was being made at the present session of the Legislature for the appointment of such an agent.

Mr. A. Blue said there was already a Crown lands agent at Rat Portage, who was supplied with blue print and other maps of the district, and provision was made in the estimates now before the Legislature for enlarging the scope of the agency. A year ago an appropriation had been taken for a collection of mineral specimens at five different points in the province, viz., Marmora, Sudbury, Sault Ste. Marie, Port Arthur and Rat Portage. These collections had now been made by Dr. Goodwin, of the School of Mining, at Kingston. He (Mr. Blue) had had the pleasure of examining one of them, which he believed was typical of all the others, and it was an admirable collection. The main use of the collections would be to assist the work of the professors who conducted the summer mining classes, and in the regulations for their management, provision would be made for throwing them open to the public.

Mr. B. T. A. Bell suggested the advisability of forming a permanent collection of the minerals of the province, to be shown at the Industrial Exhibition at Toronto.

Dr. Goodwin said they had been nearly a year making these collections, their aim being to secure Ontario representatives of the various species, which made the work somewhat slow. They were now, however, practically complete. Each collection consisted of between 200 and 250 specimens, representing particularly the valuable ores and minerals, arranged in groups. Pains had been taken to make the collections as attractive as possible. Each was placed in a polished oak case, set upon a polished oak table, provided with drawers, in which were deposited duplicate samples of the most important minerals and rocks for handling. The samples in the cases could not be handled, the covers being screwed down. Labels were placed in front of the samples, which were arranged on an incline in such a way as to be plainly seen. A descriptive catalogue had also been prepared, and he understood that Mr. Blue intended to print it in the forthcoming report of the Bureau of Mines. As far as possible, the catalogue would deal also with the uses and value of the minerals.

MR. W. HAMILTON MERRITT remarked that such collections would be very useful, by affording standard specimens to which prospectors could bring their finds for purposes of comparison. They would also serve another very important object, in bringing about the formation of local collections, for which they would be a nucleus.

DR. GOODWIN added that steps had been taken to place the collections in the hands of trustees, and to have them used under proper regulations. The cases were roomy, and would accommodate a certain number of additional specimens.

MR. B. T. A. BELL moved, seconded by Mr. W. R. White, Q.C., that resolution No. 4, as follows: "As to the formation of joint stock companies for mining purposes, be it resolved, that the Ontario Government be urged to pass an enactment, whereby such companies can obtain a charter with greater speed and at much less cost than at present," was not in harmony with the aims and views of the Institute, and be not approved.

MR. CONMEE said he believed it was the intention of the government to provide some machinery on the lines of the resolution. He thought it unnecessary, therefore, to discuss it.

MR. W. R. WHITE, Q.C., thought the very fact that a bill was pending before the House dealing with the formation of joint stock companies made it all the more important that the meeting should give expression to its views. He did not think the resolution was one which ought to be approved. There was no reason why they should wish to facilitate the obtaining of charters. It was quite easy to get one now, if the object was a proper one.

MR. CONMEE believed that the views just expressed were not those of a majority of the members of the Institute. He saw no reason why, when four or five men wished to engage in mining operations, they should be delayed for six weeks or two months while a lawyer manipulated the charter for them. In England you could get a charter in 24 hours, and in some of the States a charter for either a mining company or a railway can be had in two or three days. He believed the public interest would be served by the legislation which he understood was to be proposed.

MR. B. T. A. Bell said the question had been discussed at the late meeting of the Federated Mining Institute at Montreal and a very strong feeling had been expressed against any law which would facilitate the organization of companies such as some of those that had lately been formed. In British Columbia a law was being prepared which would have the effect of preventing the floating of these wildcat companies. The public must be protected. A committee of the Federated Institute representing four different Provinces was preparing a report which would be submitted to the Dominion and local governments protesting against any system which would allow companies with an inflated capital of six or eight millions to be formed at the instance of any worthless scalawag.

Mr. T. E. Washington, Toronto, said that three-fourths of the companies that had been formed within the last six months had taken out charters on the other side, for the reason that they could get them there for one-tenth the expense they could here, and in almost no time.

Mr. W. R. White, Q.C., thought the organization of companies whose object was not to develop a mine but to sell shares, should be surrounded with every possible safeguard, and time should be given the public to investigate their proposals. He gave an instance in which even with the existing protection an attempt had been made to incorporate a company for the purpose of building a canal which would have drowned out what he considered to be one of the best mining properties now under development in Ontario. If charters could have been got without notice being given, this company might have been incorporated before anyone was the wiser.

Mr. Conmee asked how the public could be protected by delay. Had anybody ever heard of anyone coming forward and saying that such and such a mining charter ought not to be granted? The case Mr. White mentioned was not that of a mining company at all. The proper way was for the government to determine by law what powers a company should have, and then issue charters under the Act. There would then be no object in delay. Now when the public were organizing mining companies, it was time to bring the law into harmony with the requirements of the people.

Mr. J. Van Sommer thought that the question as to the liability of promoters was of much more importance than that of the speedy issuing of charters.

Mr. J. W. Cheeseworth said the Ontario government ought to provide facilities by which Ontario capitalists might incorporate under Ontario laws, and not be obliged to go to the States for their charters. American companies doing business here were not subjected to the same inspection of books, accounts, etc., as Ontario companies.

A lively discussion was continued until 10.30 p.m., when the meeting adjourned without having expressed any opinion on the question.

THURSDAY EVENING.

The Institute re-assembled on Thursday evening for the reading of the papers set down on the programme. Mr. Kingsmill, Q.C., again presided

Unusual interest was manifested in the proceedings, the committee room being crowded, and among the most interested listeners were a number of members of the Legislative Assembly then in session.

The following papers were then read:

"Notes on the Western Ontario Gold Fields and their Genesis," by Mr. F. Hille, M.E., Port Arthur.

"Some Notes on Gold Milling," by Mr. John E. Hardman, S.B.M.E., Montreal.

"Notes on Materials used in the Manufacture of Mining Machinery," by H. W. de Courtney, Montreal.

"A New Use for Scrap Mica," by C. H. Mitchell, Toronto.

"Notes on Moss Litter," by Mr. T. W. Gibson, Toronto.

GENERAL MEETING.

HALIFAX, 28TH SEPTEMBER, 1897.

A meeting of the members of the Mining Society of Nova Scotia, was held in the Halifax Hotel, Halifax, on Tuesday, 28th September. There was a fair attendance.

NEW MEMBERS.

On motion of the Secretary, seconded by Mr. Chas. Forgie, the ballot was suspended and the following gentlemen elected members of the Society : Harry Haight (Canadian Rand Drill Co.), L. W. Getchell (Guffey-Jennings Gold Mining Co.), Caribou.

The Minutes of the last meeting were read and confirmed.

PAPERS.

A paper on "Patent Fuel" was read by Mr. Charles Archibald.

A paper on "Some Boiler Tests at Drummond Colliery," was read by Mr. Chas. Fergie.

THANKS TO U. S. GEOLOGICAL SURVEY.

On motion of Mr. Poole, a vote of thanks was passed to Chas. D. Walcott, Director U. S. Geological Survey, for the valuable addition to the Library of the Society in the form of the copies of the Report and Monographs presented. The Secretary was instructed to forward to the U. S. Geological Survey Department a complete set of the Transactions of the Society.

A sample of the so-called Sudbury coal was exhibited by Mr. Poole.

The meeting then adjourned.

APPENDIX.

CONSTITUTION AND BY-LAWS.

(AS AMENDED FEB. 1897.)

SECTION I.—NAME.

The organization shall be named the Federated Canadian Institute.

SECTION II.—OBJECTS.

The Institute shall be a federation of all, or any of the Canadian societies interested in the advancement of mining, metallurgy, engineering and their allied industries. It shall have for its objects :—

(a) The publication in one volume of the papers and proceedings of the organizations in the federation.

(b) Action upon such matters affecting or relating to the mineral industries of Canada which may be referred to it by the societies in the federation.

SECTION III.—FOUNDERS.

The original founders are as follows :—

The Mining Society of Nova Scotia ;
The General Mining Association of the Province of Quebec ;
The Ontario Mining Institute.

SECTION IV.—COUNCIL.

The affairs and business of the Institute shall be managed and controlled by a Council, consisting of the Presidents of the Societies in the Federation, and one member for every forty and fraction thereof in good standing in their respective societies, to be elected annually by each such society, said members to hold office until their successors are elected. A majority of said Council shall constitute a Quorum.

SECTION V.—ELECTION OF OFFICERS.

The Council at their annual meeting, shall elect a chairman and a secretary-treasurer, the latter to receive such remuneration as may be determined by it ; such meeting shall be held immediately after the annual meeting of the Institute.

SECTION VI.—DUTIES OF THE SECRETARY-TREASURER.

The Secretary-Treasurer shall attend all meetings of the Council and shall record the proceedings in a minute-book. He shall have charge of, and conduct all correspondence relative to the business and proceedings of the Institute and of all committees where necessary, and shall be responsible, under direction of the Council, for the editing and publication of an Annual volume of proceedings. The funds of the Institute shall be received by him and be deposited in his name, as Secretary-Treasurer, at a bank approved by the Council,

All payments on behalf of the Institute shall be made by the Secretary-Treasurer upon the approval of any member of the Council.

The accounts of the Secretary-Treasurer and the financial statement for the year shall be audited by two members of the Council. The auditors shall be elected annually at the general meeting.

SECTION VII.—FEES.

The societies of the Federation shall each pay an annual subscription towards the expenses of the Institute, of such an amount as may be determined upon by the Council, but the contribution from each society shall at no time exceed in amount the sum of three dollars for each member of such society.

SECTION VIII.—MEETINGS.

The Annual General Meeting of the Institute shall be a united meeting of the various societies in the Federation ; it shall be held on the first Wednesday in February, commencing at eleven o'clock in the forenoon of said day, or at such other time as the Council may determine.

SECTION IX.—PUBLICATIONS.

Publications of the Institute shall be supplied to members in good standing in their respective societies, one copy to each member, and the balance shall be sold by the Council at such prices at may be determined.

Contributors of papers shall be entitled to twelve copies of any paper presented by them and published by the. Institute. Additional copies shall be sold at such price as the Council may determine.

Copies of the Proceedings sent for exchange shall be accompanied with a request for such exchange to be sent to the Secretary of each society in the Federation.

The Institute as a body is not responsible for the statements and opinions advanced in the papers which may be read, or in the discussions which may take place at the meetings of the Institute or of the federated societies.

The Council may accept papers or other documents from persons who are not members of the Institute, and allow them to be published in the Proceedings.

SECTION X.

Any amendment or alteration to the Constitution or By-laws of the Institute may be made by the majority of the members of Council, such amendments to be in force until the next general meeting of the Institute, when the same must be ratified by a majority of the members of the Institute present. Notice of such amendments must be sent by the Secretary to every member of the Institute at least two weeks prior to such general meeting.

LIST OF MEMBERS.

Honorary Members.

Name of Association		
Quebec		Adams, Dr. Frank D., *McGill University, Montreal*
British Columbia		Baker, Hon. Col. Jas., *Minister of Mines, Victoria, B.C.*
Quebec		Bell, Dr. Robt., *Geological and Natural History Survey, Ottawa.*
British Columbia		Bell, B. T. A., *Editor, Canadian Mining Review, Ottawa.*
Quebec		Blue, Archibald, *Director, Bureau of Mines, Toronto.*
British Columbia		Bostock, Hewitt, M. P., *Victoria, B.C.*
Quebec	*	Chalmers, Robt., *Geological Survey of Canada, Ottawa.*
Nova Scotia and Quebec		Dawson, Sir William, L.L.D., etc., *Late Principal of McGill University, Montreal.*
British Columbia and Quebec ..		Dawson, Dr. George, C.M.G., *Director, Geological Survey of Canada, Ottawa.*
Quebec		Ells, Dr. Robert, *Geological Survey of Canada, Ottawa.*
Nova Scotia		Faribault, E. R., C.E., *Geological Survey of Canada, Ottawa.*
do		Fletcher, Hugh, B.A., *Geological Survey of Canada, Ottawa.*
Ontario		Gibson, Hon. J. M., *Commissioner of Crown Lands, Toronto.*
Nova Scotia and Quebec		Gilpin, Dr. E., Jr., *Deputy Commissioner and Inspector of Mines, Halifax, N.S.*
do		Hardy, Hon. A. S., *Premier of the Province of Ontario, Toronto.*
Nova Scotia		Hind, Dr. Henry Y., *Windsor, N.S.*
Quebec		Ingall, E. D., M.E., A.R.S.M,, *Chief of Division of Mineral Statistics, Geological Survey of Canada, Ottawa.*
Quebec		Low, A. P., B. Ap. Sc., *Geological Survey of Canada, Ottawa.*
British Columbia		McConnell, R. G., *Geological Survey of Canada, Ottawa.*
do		McEvoy, Jas., *Geological Survey of Canada, Ottawa.*

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* Prefixed to a name indicates the contributor of a paper published in this volume of the Journal.

British Columbia		Maxwell, G. R., M.P., *Vancouver, B.C.*
Quebec.........		Obalski, J., M.E., *Inspector of Mines, Quebec.*
do	*	Poole, Henry, M.A., A.R.S.M., F.G.S., *Acadia Coal Co., Stellarton, N.S.*
Nova Scotia and Quebec.......		Raymond, Dr. Rossiter W., *Secretary, American Institute of Mining Engineers New York.*
Nova Scotia.....		Rutherford, John, M.E., *Late Inspector of Mines for Nova Scotia, Windsor, N.S.*
Quebec.........	*	Selwyn, Dr. A. R. C., C.M.G., etc., *Late Director, Geological Survey of Canada, Vancouver, B.C.*

MEMBERS.

Name of Association.		
Quebec and Ontario..........		Allan, W. A., *Mine Owner, Victoria Chambers, Ottawa.*
Quebec.........		Adams, Capt. R.C., *Adams British Columbia Co. Ltd., Sandon, B.C.*
Nova Scotia.....	*	Archibald, Charles, M.E., *Halifax, N.S.*
do		Anderson, John, *Mine Owner, Musquodoboit Harbor, N.S.*
do		Austen, Joseph, *Mine Owner, Country Harbor, N.S.*
Ontario.........		Ahn, Robt H., *Rat Portage, Ont.*
do		Andrews, E. *Grimsby, Ont.*
Quebec.........		Brown, D. Austin, *Bell's Asbestos Co. Ltd, 77 Pearl St., Boston, Mass.*
do		Blue, John, C. & M.E., *Eustis Mining Co., Capelton, Que.*
Quebec, Ontario and Nova Scotia.		Bell, B. T. A., *Editor Canadian Mining Review, Ottawa.*
Quebec.........		Bacon, F., *377 St. Paul St., Montreal.*
do		Brainerd, Dwight, *Hamilton Powder Co., Montreal.*
do		Buck, F. P., *Dominion Lime Co., Sherbrooke.*
do		Boas, Feodor, *Asbestos and Asbestic Co., St. Hyacinthe, Que.*
do		Belcourt, N. A., Q.C., M.P,, *Wallingford Mica Co., Ottawa.*
do		Bowen, Cecil H., C.E., *Cobourg, Ont.*

Quebec		Budden, H. A., *Intercolonial Coal Co., Montreal, Que.*
do		Baker, H. C., Ba. Sc., *Blackburn Mine, Perkins Mills, Que.*
do		Bonner, W. T., *Montreal, Que.*
do		Brown, J. Stevenson, *Notre Dame St., Montreal, Que.*
Nova Scotia		Baird, James, *Lessee, Joggins Colliery, Maccan, N.S.*
do		Bell, Hon. A. C., M.P., *New Glasgow, N.S.*
do		Brown, R. H., M.E., *General Manager, General Mining Association, Limited, Sydney Mines, Cape Breton.*
do		Burchell, J. T., *Colliery owner, New Campbellton, C.B.*
do	*	Blakemore, Wm., M.E., *General Manager, Crow's Nest Coal Co., Limited.*
do		Boak, G. E., *Mine owner, Halifax, N.S.*
do		Brine, W. C., *Halifax. N.S.*
British Columbia		Bellamy, H. R., *Nelson, B.C.*
do		Binnie, T., *Assayer, New Westminster, B.C.*
do		Bledsoe, J. F., *Alberni, B.C.*
do		Bucke, M.A., M.E., *Kaslo, B.C.*
do		Bray, M., *Mining Recorder, Nanaimo, B.C.*
do		Buchar, — *Prospector, Lillooet, B.C.*
Ontario		Burroughs, Fred., *Napanee, Ont.*
do		Birkett, T., *Kingston, Ont.*
do	*	Bawden, Joseph, *Mine owner, Kingston, Ont.*
do		Blue, Archibald, *Director of Mines, Toronto, Ont.*
do		Burke, D. F., *Mine owner, Port Arthur, Ont.*
do		Breidenbach, Theo., M.E., *Mikado Gold Mining Co., Rat Portage, Ont.*
do		Burns, C. B., *Bodega Chambers, Ottawa.*
do		Brown, J. W., *9 Toronto St., Toronto, Ont.*
do		Bousted, W. E., *School of Practical Science, Toronto.*
do		Burwash, Prof. John, *695 Spadina Avenue, Toronto, Ont.*

Quebec.........		Cooper, James, *Hay Island Gold Mining Co., Montreal.*
do		Carriere, C. H., *Levis, Que.*
do		Chouillou, L., *St. John St., Montreal.*
do		Cirkel, F., M.E., *Ottawa, Ont.*
do		Colby, Hon. C. C., *Mine owner, Stanstead, Que.*
Quebec, British Columbia and Ontario.......		Carry, H. E. C., C.E., *79 Bay St., Toronto, Ont.*
Nova Scotia.....		Chambers, R. E,, M.E., *Nova Scotia Steel Co., Ferrona, N.S.*
do		Clendennin, J. W. *Acadia Coal Co., 1 Broadway, New York.*
do		Cowans, J. R., *Cumberland Ry. and Coal Co., Springhill, N.S.*
British Columbia		Callahan, C. W., *Galena Mines Ltd., New Denver, B C.*
do		Carlyle, W. A., M.E., *Provincial Mineralogist, Victoria, B.C.*
do		Clark, Roy, M.E., *Rossland, B.C.*
do		Colquhoun, A. J., M.E., *Rossland, B.C.*
British Columbia and Ontario ..		Cotterill, T. C., M.E. *London, Eng.*
British Columbia		Cowell, W. J. R., *Metallurgist, Victoria, B C.*
do		Croft, H. C., C.E., *Rossland, B.C.*
Ontario.........		Caldwell, John F., *Owner, Sultana Mine, Rat Portage, Ont.*
do		Carruthers, J. Bruce. *Kingston, Ont.*
do		Conmee, Jas., M.P.P., *Port Arthur, Ont.*
do		Clark, J. M., *Toronto, Ont.*
do	*	Coleman, Dr. A. P., *Provincial Mineralogist, Toronto.*
do		Cheeseworth, H. W., *Toronto, Ont.*
do		Carscallan, A. W., *Marmora, Ont.*
do		Cooper, W. J., *15 Imperial Bank Bdg., Toronto.*
do		Chewett, J. H., C.E., *Rossin House Block, Toronto.*
do		Connor, M. F., B.A., Sc., *Bank Street Chambers, Ottawa.*
do		Clark, S. C. Duncan, *52 Canada Life Bdg., Toronto.*

Ontario		Cox, E. Strachan, *Toronto, Ont.*
do		Clark, C. B., *Yonge St., Toronto*
do		Curzan, Sydney R., *Victoria Club, Toronto.*
do		Clark, C. P., *Barrie, Ont.*
do		Cotterill, J., *Toronto, Ont*
Quebec.........	*	Drummond, George E., *Canada Iron Furnace Co., Canada Life Building, Montreal, Que.*
do		Drummond, T. J., *Montreal Car Wheel Co., Canada Life Building, Montreal, Que.*
do		Drummond, John J., M.E., *Canada Iron Furnace Co., Radnor Forges, Que.*
Quebec and Ontario..........	*	De Courtenay, H. W., *15 St. Helen St., Montreal, Que.*
Quebec.........		Donald, J. T., M.A., *112 St. Francois Xavier St., Montreal.*
Nova Scotia.....		Dimock, C. H., *Wentworth Gypsum Co., Windsor, N.S.*
do		Drysdale, Arthur, Q,C., M.P.P., *Halifax, N.S.*
Nova Scotia and British Columbia		Dick, Alexander, *Rossland, B.C.*
Nova Scotia.....		Davidson, B. M., *Halifax, N.S.*
do		Donkin, Hiram, C.E., *Dominion Coal Co., Glace Bay, C.B.*
do		Drury, H. A., *St. John, N.B.*
British Columbia		Dick, Alexander, M.E., *Inspector of Mines, Nanaimo, B.C.*
Ontario.........		Dupuis, Prof., *Queen's University, Kingston, Ont.*
do		Davis, Thos., *River and Queen Sts., Toronto, Ont.*
do		Donnelly, John, *Kingston, Ont.*
do		Doud, E., *Hamilton Blast Furnace Co., Hamilton, Ont.*
Quebec.........		Eustis, W. E. C., *Eustis Mining Co., Boston, Mass.*
do		Franchot, S. P., *Mine Owner, Buckingham, Que.*
do		Fleck, Alex., Jr., *Ottawa, Ont.*
do		Fleck, A. W., *C. A. Ry., Ottawa.*
do		Foley, Jas., *Petroleum Oil Trust, Ltd., New York Life Bd'g, Montreal, Que.*

Nova Scotia.....	*	Fergie, Chas., M.E., *Intercolonial Coal Co., Westville, N.S.*
do		Francklyn, Geo. E., *General Mining Assn., Ltd., Halifax, N.S.*
do		Fraser, Graham, *Nova Scotia Steel Co., New Glasgow, N.S.*
British Columbia		Francis, G. F., M.E., *Swansea, South Wales, England.*
Ontario.........		Folger, B. F., *Kingston, Ont.*
do		Faye, E., *Toronto, Ont.*
do		Fenton, F. A., *203 Church St., Toronto, Ont.*
Quebec.........		Gilman, E. W., *Canadian Rand Drill Co., Board of Trade Building, Montreal, Que.*
do		Grundy, Frank, *Quebec Central Railway. Sherbrooke, Que.*
Nova Scotia.....		Graham, Harvey, *Nova Scotia Steel Co., New Glasgow, N.S.*
do		Gue, T. R., *Mine owner, Halifax, N.S.*
do		Getchell, L. W., *Caribou, N.S.*
Ontario.........		Goodwin, Dr. W. L., *Director, School of Mining, Kingston.*
do		Gliddon, J. N., *Canadian Copper Co., Sudbury, Ont.*
do		Gibson, T. W., *Bureau of Mines, Toronto, Ont.*
do		Gray, Fred. W., *Guelph, Ont.*
British Columbia		Gowen, W. E., F.H., *Providence Mine, Harrison Lake, B.C.*
do		Gwillim, J. C., B.A.Sc., M.E., *Slocan City, B.C.*
Nova Scotia, Quebec and Ontario	*	Hardman, John E., S.B., *Room 2, Windsor Hotel, Montreal.*
Nova Scotia.....		Howe, C. Fred., C.E., *Barbadoes.*
do		Hayward, A. A., M.E., *Golden Lode Mining Co., Halifax.*
do		Howard, Capt. A. L., *Brownsburg, Que.*
do		Hargreaves, C., *Cumberland Ry. & Coal Co., Springhill, N.S.*
Nova Scotia.....		Harding, E. H., *(Brookfield Mining Co.), N. Brookfield, N.S.*
do		Hampson, J. E., *Halifax, N.S.*
do		Haight, Harry, *Halifax, N.S.*
Quebec....		Heinze, F. Aug. *(B. C. Smelting & Refining Co., Trail, B.C.*

Quebec		Hamilton, Wm., Jr., M. E., *(Wm. Hamilton Manufg. Co.), Peterborough, Ont.*
Quebec and British Columbia.		Hobson, John B., M. E., *(Cariboo Hydraulic Mining Co.) Quesnelle, B.C.*
Quebec		Hersey, Milton, L., BA. Sc., *16 Sacrement St., Montreal.*
do		Hopkins, Frank H., *(Dominion Wire Rope Co.), Montreal.*
do		Hopper, R. T., *Anglo-Can. Asbestos Co.), Board of Trade Bdg., Montreal, Que.*
do		Higginson, J, F., *(Mine Owner) Buckingham, Que.*
do		Hill-Catherine, W. J., M.E., *London, Eng.*
Ontario	*	Hille, F., M.E., *Port Arthur, Ont.*
do		Hall, Edward C., M. & M.E., *Mines Centre, Ont.*
do		Hammond, Herbert C., *Toronto, Ont.*
do		Hime, W. L., *Toronto, Ont.*
do		Haycock, E. B., *Mine Owner, Ottawa.*
do		Hall, F. A., *15 Howland Avenue, Toronto.*
do		Hartstone, Major, *239 Beverley St., Toronto.*
British Columbia		Harris, H., A.R.S.M., *Vancouver, B.C.*
do		Hedley, Robert R., M.E., *Hall Mines, Ltd., Nelson, B.C.*
do		Hill, A. F., Mem. Can. Soc. C.E., *New Westminster, B.C.*
do		Holdich, A. H., A.R.S.M., *Nelson, B.C.*
do		Hodgins, A. H., M. Can. Soc. C.E., *Nelson, B.C.*
do		Howard, W. C., Ph. D., *Vancouver, B.C.*
do		Hughes, T. D., M.E., *Victoria, B.C.*
Quebec		Innes, F. C., *Cinnabar Mining Co., Vancouver, B.C.*
do		Johnson, Andrew S., *Johnson's Co., Ltd., Thetford Mines, Que.*
do		Jenckes, J. M., *Sherbrooke, Que.*
do		Jones, R. H., F.S.A., *The "Grange," Gunnersbury, London W., Eng*
Ontario.........		Jarvis, E. J., *Toronto, Ont.*
do		Jackes, C., *18 Court St., Toronto, Ont.*
British Columbia		Johnstone, R. C. Campbell, M.E., *New Denver, B.C.*

British Columbia		Johnson, M. S., M.E., *Slocan City, B.C.*
Nova Scotia.....		Jenner, E. T. L., *Sherbrooke, N.S.*
Quebec.........		King, Col. Chas., *Sherbrooke, Que.*
do		King, James, *King Bros., Quebec, Que.*
Ontario.........		Kent, — *Kingston, Ont.*
do		Kingsmill, J. J., Q.C., *19 Wellington St. W., Toronto, Ont.*
do		Kirkpatrick, G. B., *Crown Lands Dept., Toronto, Ont.*
do		Klock, R. A., *Klock's Mills, Ont.*
do		Kennedy, H. W., *Rat Portage, Ont.*
do		Koppleman, M., *Portland, Conn.*
do		Knowlton, W. H., *26 King St. East, Toronto, Ont.*
Nova Scotia.....		Leckie, R. G. E., M.E., *Truro, N.S.*
do		Leckie, Major, R. G., *Dufferin Gold Mining Co., Truro, N.S.*
do		Leckie, J. E., *Torbrook Iron Co., Truro, N.S.*
do		Libbey, W. L., *Brookfield Mining Co., North Brookfield, N.S.*
Quebec.........		Loomis, D. G., *Sherbrooke, Que.*
do		Lawrence, H. D., *Sherbrooke, Que.*
do	*	Lewis, J. F., M.E., *Monadnock Bdg., Chicago, Ill.*
Ontario		Latimer, J. F., *13 St. Patrick St., Toronto, Ont.*
do		Laidlaw, J. Turnbull, *78 St. Albans St., Toronto, Ont.*
do		Ledyard, T. D., *57 Colborne St., Toronto, Ont.*
do		Leonard, R. W., C.E., *Beauharnois, Que.*
do		Laughlin, J. T., *35 Adelaide St. E., Toronto.*
do		Leechman, John, A.R.S.M., *Rat Portage, Ont.*
British Columbia		Latimer, F., P.L S., *Vernon, B.C.*
do		Loring, Frank, M.E., *Josie Gold Mining Co., Rossland, B.C.*
Quebec and Ontario..........		Morgan, C. E., *Northey Mnfg. Co., Toronto, Ont.*
Quebec.........		Munroe, Robt., *Montreal, Que.*

Quebec		Mitchell, J. S., *Beaver Asbestos Co., Sherbrooke, Que.*
do		Mitchell, W., *Drummondville, Que.*
do		Marcuse, B., *Asbestos & Asbestic Co., Danville, Que.*
do		Martin, R. H., *American Asbestic Co., New York.*
do		Mann, D. D., *North Star Mining Co., Montreal.*
do		Miller, Spencer, Mem. Am. Soc. C. E., *96 Liberty St., New York.*
do		Macdonald, A., *St. John's, Que.*
do		McDougall, George, *85 Osborne St., Montreal.*
do		McCall, Jas. T., *Canada Life Bdg., Montreal.*
Nova Scotia		Morrow, Geoff, *Halifax, N.S.*
do		Mosely, Hon. E. T., *Sydney, C.B.*
do		Matheson, W. G., *New Glasgow, N.S.*
do	*	Mason, F. H., F.C.S., *Halifax, N.S.*
do		Morrow, M. R., *Halifax, N.S.*
do		Meissner, C. A., *Londonderry Iron Co., Londonderry, N.S.*
do		MacKeen, Hon. David, *Halifax, N.S.*
do		McLennan, John S., *Dominion Coal Co., Boston, Mass.*
do		McKay, H. S., *54 Devonshire St., Boston, Mass.*
do		McGregor, Jas. D., M.P.P., *New Egerton Mining Co., New Glasgow, N.S.*
do		McInnes, Hector, *Halifax, N.S.*
do		McKenzie, Hugh D., *Halifax, N.S.*
do		McAvity, George T., *St. John, N.B.*
do		McDonald, Duncan, *Truro, N.S.*
Ontario		Millar, Prof,, *School of Mining, Kington, Ont.*
do		Merritt, W. Hamilton, A.R.S.M., *Toronto St., Toronto, Ont.*
do		Mickle, Geo. R., M.E., *School of Practical Science, Toronto.*
do		Marks, Thos., *Port Arthur, Ont.*
do		Minnes, Jas., *Kingston, Ont.*

Ontario.........		Mason, Wm., *School of Mining, Kington, Ont.*
do		McKellar, John, *Fort William, Ont.*
do		McArthur, Jas., *Canadian Copper Co., Sudbury, Ont.*
do		Musgrave, Dr. James, *Toronto, Ont.*
do		Musgrave, Thos., *Cork, Ireland.*
do		Musgrove, E., *Kingston, Ont.*
do		Marks, Geo. T., *Port Arthur, Ont.*
do		McKellar, Peter, *Fort William, Ont.*
do		McAree, John, D.L.S., *Rat Portage, Ont.*
British Columbia		MacCartney, A. E., P.L.S., *Vancouver, B.C.*
do		McCulloch, W. F., *Kamloops, B.C.*
do		McKenzie, D. J., *Alberni, B.C.*
do		McLean, W., *Vancouver, B.C.*
do		Macgregor, W., *New Vancouver Coal Mining & Land Co., Nanaimo, B.C.*
do		Merry, H. E. D., A.R.S.M., *Rossland, B.C.*
do	*	Moncton, G. F., F.G.S., *Vancouver, B.C.*
do		Morrish, Capt. J., *New Gold Fields of B C., 23 Leadenhall Street., London.*
do		Morrison, D. K., *Rossland, B.C.*
do		Macartney, S., *Savonas, B.C.*
do		Macraney, W., *Vancouver, B.C.*
do		Matthews, T., *Vancouver, B.C.*
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do		Parks, W. A., *The University, Toronto, Ont.*
do		Pearson, Jas., *1 Toronto St., Toronto.*
do		Proudfoot, H. B., *33 Tranby Avenue, Toronto.*
do		Picard, Hugh F. K., *Canadian Gold Fields Ltd., Marmora, Ont.*
do		Pringle, H. H., *Manager, Regina (Canada) Gold Mine, Rat Portage, Ont.*
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do		Reilly, J. F., *Slocan City, B.C.*

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do		Stull, Wm., *Georgetown, Ont.*
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Nova Scotia.....		Taylor, Frederick, *121 School St., Lowell, Mass.*
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do		Tye, A. T., *47 Ulster St., Toronto, Ont.*
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do		Weston, Henry S., *Melrose, N.S.*
do		Weston, W. H., *Melrose, N.S.*
Ontario		Webber, John, *464 Spadina Avenue, Toronto.*
do		Willson, Alfred, *Canada Company, Toronto.*
do		Whitson, J. F., *Crown Lands Dept., Toronto, Ont.*
do		White, Aubrey, *Deputy Commssioner of Crown Lands, Toronto, Ont.*
do		Walker, T. L., M.A., *School of Mining, Kingston, Ont.*
do		Williams, B. J., *329 Preston Avenue, Toronto, Ont.*

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do		Wilson, Chas. M., *Assayer, Sandon, B.C.*
do		Wilson, H. B., *Assayer, Lillooet, B.C.*
do		Wolcott, J. R., *Vancouver, B.C.*
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STUDENT MEMBERS.

Thomson, H. N., Box 225, Quebec, Que.
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